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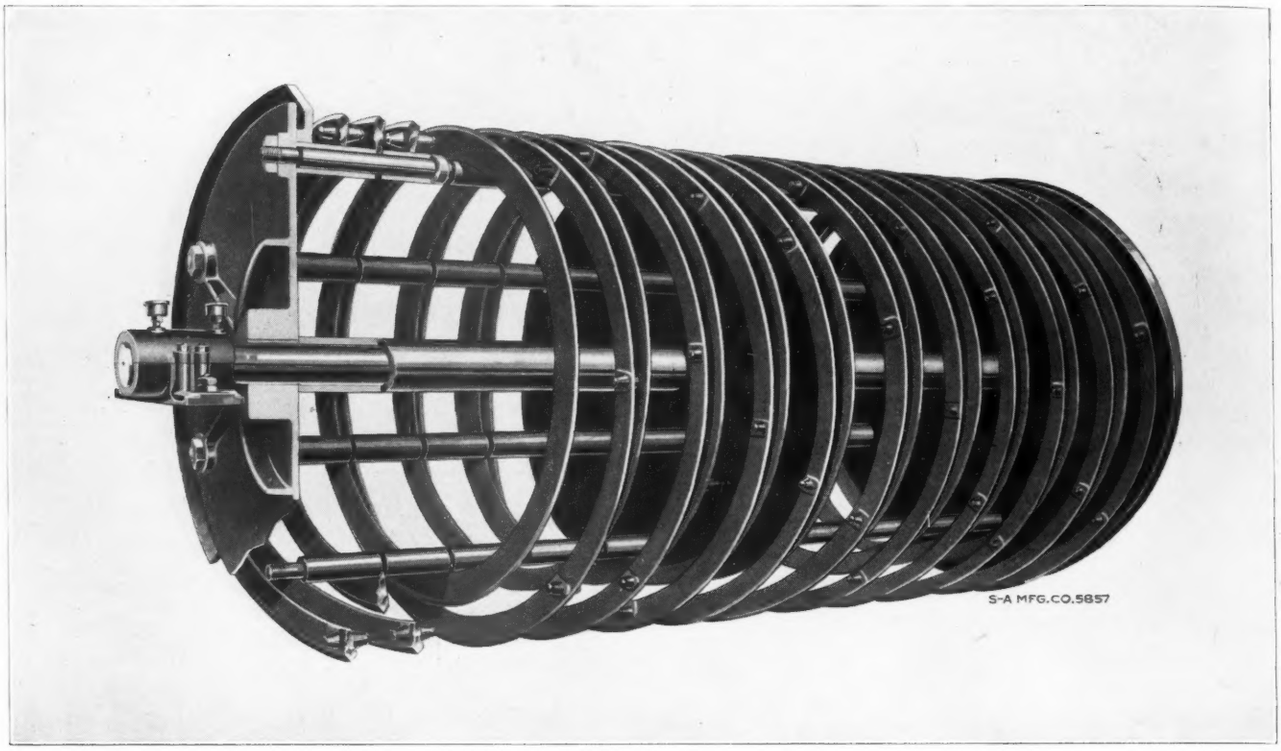
A WEEKLY JOURNAL REPRESENTING THE WORLD'S MINING AND METAL INDUSTRIES

May 5, 1923



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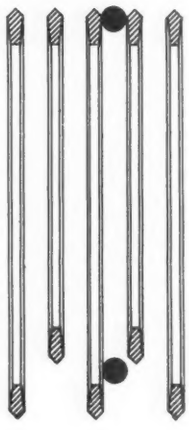

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ENGINEERING & MINING
JOURNAL-PRESS
JOSIAH EDWARD SPURR, Editor

Volume 115 New York, May 5, 1923 *Number* 18

Completion of Pittman Act Purchases

ADJUSTMENT of the final operation of the Pittman Act on an equitable basis is to be expected as a result of conferences between the various authorities in Washington. Senator Pittman, the author of the Act, and Senator Oddie, chairman of the Senate Commission of Gold and Silver Inquiry, have both written to the *Journal-Press*, congratulating it on its vigorous stand for the silver miner and expressing full agreement with the editorial position which we have taken.

It is to be expected, pending definite adjustments with the mint, that the millmen will assume that they are on the same basis as the smelter men, as to tendering the silver in ores already produced but not yet reduced for future delivery. The mint can hardly do otherwise than take this point of view; and in case the total amount thus tendered by the smelter men and the millmen should be in excess of the total to be purchased under the Act, it is natural that a pro rata adjustment should be made. As to the 10,000,000 oz. which were allotted for subsidiary coinage, and which we must believe that the mint will finally decide that it is mandatory to purchase under the provisions of the Act, producers of silver, whether the smelter men or millmen, would perhaps be shrewd in assuming, even in advance of any decision, that the mint will so decide, and would perhaps be wise in making formal tenders of the additional 10,000,000 oz. in question over and above the amount which the mint announced it would buy, according to the statement of the Director on March 30. If the mint decides to purchase, there can then be no question as to from whom the amount should be bought; and if the mint does not so decide, the producers who have had their tenders refused have a definite basis for claim, with which to go before Congress, asking for reparation and a settlement of their bill, which we believe Congress should and would recognize.

Mexico and Article 27

NEWS COMES from Mexico City that the Chamber of Deputies, by a vote of 102 to 28, has approved Article 5 of a new petroleum law, which article confirms petroleum rights legally acquired before May 1, 1917, when the present constitution (Article 27 of which vests the ownership of mineral lands, including those of petroleum, in the state) became effective. This article was designed to meet the complaints of American owners of oil lands in Mexico, that Article 27 of the new constitution is confiscatory of legally acquired properties and interests. This view has also been taken by the State Department in Washington, which has been firm in the view that American capital, invested legally and with the best of intentions, should not be disregarded and practically confiscated by any new theory on the part of any government, whether that of Mexico or that of Russia. The attitude of the State Department has been sound; and the government of Mexico has not been without a clear appreciation of the soundness of that position; but, hitherto, motives of political expediency have interfered with the full recognition by Mexico of the justice of the American representations, since it has been held that such an acknowledgment would meet the disapproval of the population and possibly the overthrow of the government. Evidently, however, the Mexican Chamber of Deputies has at last quite firmly made up its mind to this sensible step.

So far as we know, this was the main thing which stood out against the recognition of the Obregon government by the United States. The State Department in Washington has indicated this rather clearly on many occasions; and the Mexican government has fully understood the situation. We hope that recognition will soon follow. With an ear to the ground, we cannot but decide that the general status in Mexico is more favorable than it has ever been, at least since the first revolt against Diaz began. And even the situation under Diaz, with relative and outward prosperity, and protection for foreign investors, was fundamentally unsound, so that the consequent upheaval was inevitable. Raw and in part chaotic as present conditions may be, the background is more solid and favorable than even in Diaz's time.

Americans have difficulty, apparently, in getting a just and intelligent view of Mexico; they worry more and talk and write more about Ireland and Turkey than about this populous nation at our doors. A recent series of articles in the *New York Tribune* reflected unfavorable criticism as to the breaking up and partition among the peasantry of the feudal estates of Mexico, showing how, in certain places, cultivation of the soil had diminished, and production fallen away. The writer did not visualize the two sides to the problem. The great landed estates were an Old World condition in Mexico and a bar to the development of the Mexican people. Many other nations, beginning with France, have had to overthrow these conditions with violence. The writer referred to was guided around principally by representatives of the despoiled aristocracy, men whose gentlemanly qualities awakened sympathy in his breast, as he viewed their loss of ancestral wealth, and their great houses turned into dirty barracks. Yet these feudal estates were in a large measure taken by force and legal trickery from the original small farmers, who had long owned and occupied them, as was commonly reported, for example, of the Terrazas family, who acquired, as political favorites, a large part of the State of Chihuahua. In fact, the feudal system has flourished in Mexico, since the time of the Spanish Conquest; and the breaking up of it was a blessing and will eventually be heralded as a great achievement. The Mexican people—descendants of the civilized Aztecs and in part of the Spanish conquerors—are susceptible of great development and culture, given the opportunity

which Americans inevitably demand for themselves.

It would now be a wise and friendly act to recognize the Obregon government. The mining industry has a very large interest in Mexico and in her prosperity; and recognition would surely be followed by a revival of metal mining.

The Transportation of Ores and Metals

IN THE EARLY DAYS of American mining a smelter was generally built wherever it was thought advisable to do so from the standpoint of ore supply, regardless of its location with reference to adequate and cheap transportation facilities. The smelter was erected first and freight rates were considered afterward. Nowadays, freight rates are considered first and the smelter is established only if, and when, assurance is given that low transportation charges will be provided to insure a steady and large flow of ores and concentrates to the plant.

Before the Interstate Commerce Commission was established, rates determined by the railroad were competitive when necessary, or monopolistic when possible. The system was subject to many abuses—rebates, cutthroat competition, and other related developments. Happily, this condition has been corrected. At that time little attempt was made to give the matter of transportation the attention it deserved. True, it often received the close attention of mining executives, but only a comparatively slight effort was made to segregate the interests of mining and smelting companies in transportation from the numerous others required in the conduct of a large enterprise.

Gradually the older order changed. The I.C.C. was founded. The country grew by leaps and bounds. Manufacturing spread intensively over the eastern seaboard area and reached for the West. The transportation of raw materials and finished manufactures became more and more complex. In fact, it became so complex that the undivided attention of specialists generally known as traffic managers was required. The traffic department of a large mining company is now a vital part of the machine. It has its fingers on the railway pulses of the country and is thoroughly familiar with the myriad rates, rules, and regulations that govern the shipment of a ton or a thousand tons of supplies and products from one place to another. It can bring about great savings by economical routing of materials. The importance of the work of such a department cannot be exaggerated.

In view of the importance of the subject we have included in the market section of this issue a page of freight rates covering various metals, ores, and concentrates between selected mining, smelting, and refining points. The data give a good picture of the cost of moving these commodities from mine to treatment plant. The points have been chosen so as to enable a general survey of transportation rates upon mineral products to be made. We believe this the first time any such comprehensive compilation has been published by a mining journal. From time to time we hope to add rates covering territory not now included in the scope of the table, and we ask the indulgence of our readers if they find the rate they are particularly interested in omitted.

A little study of the compilation will amply repay itself, as many interesting facts regarding present-day transportation conditions are disclosed. For example, the railroad companies are meeting with strong competition from ocean carriers in the transportation of copper from far western points to the eastern seaboard. This is because the water rate from Pacific to Atlantic points is only about $4 per ton via the Panama Canal, Hence, Montana shippers, to take one case, can send their copper by rail to the Pacific Coast for about $7 per ton, load it on vessels, and send it by water to Atlantic seaboard refineries for about $4 more (exclusive of transfer charges). The all-rail rate is about $16.50 per ton, so that a considerable saving may be made. Similarly, Arizona shippers can ship through the Gulf ports. The table also brings out the variation in freight rates on ores and concentrates with the value of the product shipped. The actual metal or mineral content is a subordinate consideration.

Transportation charges are such a significant element of production and marketing costs that they may be a controlling factor in determining whether a mineral product can be successfully mined and sold. This is especially true of the non-metallics, which are of low value compared with metalliferous ores and concentrates and consequently cannot stand high freight rates. As a matter of fact, the area in which many non-metallics can be shipped—and this applies principally to the heavy bulky products—is limited by the railroad charges.

For the present we contemplate publishing the table in the first issue of each month. The rates quoted are those in effect at the time of publication and are established by the I.C.C. As such they are subject to change by the regulations and decisions of that organization. These changes may occur before they can be given publicity in our pages, but generally ample notice is provided.

Quarry and Mine

WHAT IS THE DIFFERENCE between a quarry and a mine? Let Mr. Edison answer offhand, if he can, in a few words. Let him not say that a quarry is open to the sky, a mine shut off from the heavens. The iron mines of the Mesabi, the Utah Copper deposits, are iron and copper mines, not quarries.

The publishers of a "Directory of Mines and Quarries" write to us concerning this matter. "The problem," they say, "is properly to define 'Mine' and 'Quarry.' We must place each company under one of these two classifications. The difficulty arises from the fact that certain minerals fall naturally into a sort of 'twilight' zone, which might be called either a mine or a quarry. Included in this class are asbestos, mica, talc, feldspar, fluorspar, gypsum, magnesite, etc., which seem to have adopted the name either of 'mine' or 'quarry,' presumably according to the ultimate destination of their products."

The dictionary does not help us out very much in this matter. Webster defines a mine as "A subterranean cavity or passage: especially a pit or excavation in the earth, from which ores, precious stones, coal, or other mineral substances are taken by digging: as, a gold mine; an asphalt mine;—distinguished from the pits, called quarries, from which stone (as for building or for making lime) is taken."

This definition would seem to place the cavities whence the non-metallic minerals (as well as the metallic minerals) are taken, as mines, whether open-cast or underground, but elsewhere under "quarry" the dic-

tionary states that where the distinction is drawn between "mine" and "quarry," "mine denotes underground workings and quarry denotes superficial." So the issue is muddy.

One of our staff offers the following definition:

"Mine is the more comprehensive term. All quarries are mines. Why not establish this distinction: a quarry (from *quadrare*: to square—to hew) is an open-cut mine producing massive blocks which only need shaping or trimming to be ready for the market.

"Then

granite quarry	asbestos mine
marble quarry	placer gold mine
slate quarry	iron mine
limestone quarry (if used for building blocks)	clay mine
	feldspar mine
	gypsum mine
	magnesite mine
	fluorspar mine
	mica mine
	talc mine
	limestone mine (if used for flux)."

We shall be glad to have our readers frame a better definition if they can. When is a mine not a mine?

Internationalism and the Mining Industry

MANY PEOPLE in this country who think themselves at least 100 per cent Americans believe that we as a nation should maintain a hands-off policy with respect to foreign countries, particularly Europe, and let the victims of the World War—and this includes all the combatants—get along as best they can. They argue that we have done enough by our part in bringing the war to a conclusion, and that we should not further entangle ourselves in European affairs. They point to the present prosperity of this country as contrasted with the continued unsettled conditions in Europe as evidence that we are gainers by a policy of isolation such as this country has so far maintained.

That we are now in a period of prosperity is evident. Those who have invested money in the industries of the country are in general getting a satisfactory return on their investments, and men who are willing to work have the opportunity to do so. The United States is prosperous, but is it possible that it is prosperous despite conditions in Europe and despite the present high tariff? Would it be more prosperous, and would the prosperity be longer continued, if conditions abroad were satisfactory?

Let us consider the international situation from the standpoint of the industries that we are most interested in, and about which we have the most available data. Why is the price of copper low compared with that of other commodities, and why has it been found impossible to maintain the 17c. level during the last few weeks? The answer may be largely found in the export market. Despite the great scarcity of copper abroad, and the immense potential demand, Europe took less copper last year than in pre-war years, and so far in 1923 exports have also been slightly less than the pre-war average. In the last few weeks copper buying in Europe has been almost negligible, owing to the French invasion of the Ruhr and to upset exchanges growing out of that and other political and financial disagreements. If the foreign demand for copper had continued during the last few weeks even on the former modest scale, it is unlikely that the recent recession of the price below 17c. would have occurred. And if sufficient credits were available in France, Germany, and Italy—to name our three most important potential markets—the hydro-electric and other electrical developments in those and other countries would require 100,000,000 or 150,000,000 lb. of American copper monthly, instead of the present supply of a little over 60,000,000 lb., and the price might be 20c. instead of 17c.

Why has the lead market been weaker recently, the price dropping below the 8c. level at the same time that domestic consumption is at a record rate and that supplies for prompt delivery are extremely scarce and command a premium? This is a most unusual condition. The reason is simply that European demand is dropping off; European prices have weakened because consumers cannot afford to buy, and lead is therefore being shipped to this country, weakening the market here. French demand, especially, has diminished. Owing to lack of credits, the rebuilding of the devastated areas, for which large quantities of lead and zinc would be required, has been curtailed. In England, the building industry has also seen troublous times.

Why has zinc declined? Because there is no longer any chance for exports from the United States to Europe, owing to lessened industrial activity abroad. It was these very exports which last year assisted greatly in sending the price up to nearly 8c., and it was the resale in the domestic market of zinc already sold for future delivery abroad that started the price recession.

What of silver? What would be the price of foreign silver—on which domestic producers are so soon going to be dependent—if the European countries were able to resume silver coinage; if they had not been compelled to melt their silver and throw it on the market; and if those countries that have managed to retain silver coinage had not found it necessary to make a drastic reduction in its fineness? If financial conditions are straightened out in Europe, there will be a market for a lot of silver.

The international situation is not, therefore, one which the mining industry in this country can afford to forget. It appears to be money in our pockets to have European political conditions stable, and to have European financial affairs adjusted so that the metal supplies so urgently needed abroad may be bought.

Canada and the American Institute

MR. E. P. MATHEWSON, as president of the A. I. M. E., was the honored guest of the Canadian Institute recently at Montreal, and on that occasion claimed—it is reported by Mr. Alexander Gray in our issue of March 17—to be "the first Canadian-born president of the American society." This is a curious error; evidently he forgot that three of his predecessors in the presidential office had been Canadians. Richard P. Rothwell, the editor of the *Engineering and Mining Journal*, was president in 1882. He was born at Oxford, in what was then Upper Canada and is now the Province of Quebec. James Douglas, who was twice president, in 1899 and 1900, was born in the city of Quebec. Mr. David W. Brunton likewise was president twice, in 1909 and 1910. He was born at Ayr, in Ontario. It is no accident that five times—and now six—the president of the Institute has been a native of Canada, for our excellent neighbors of the North have given to the American mining and metallurgical profession a number of men of the first rank.

DISCUSSION

"Engineering and Mining Journal-Press" is not responsible for statements or opinions published under "Discussion." In many cases the views expressed are diametrically opposed to editorial policy and belief.

Silver Supply and Demand

THE EDITOR:

Sir—The article recently published regarding silver contained the suggestion that those interested in a higher market price for silver should encourage and develop the use of silver. Demand and supply control prices, despite all efforts of individuals (or groups of individuals) seeking to effect an artificial control, though it is likewise very true that the producer sometimes receives a small portion of the market price, due to improper methods of marketing.

Form your marketing association or export association—but do not stop there! As the writer indicated, the interest and carrying charges on large stocks of silver will tend to defeat the purpose for which the association was formed. You must endeavor to increase the demand for silver.

The miner and silver producer are essential entities in our commonwealth. They are entitled to use every lawful method to advance their interests, just as the bankers are so entitled to advance their interests. Of course such endeavors should be toward their own good and the good of the commonwealth. I believe that the above is plain Yankee doctrine and not Bolshevism or Socialism.

Demand silver money—not free silver, but encourage the use of silver coins and Treasury certificates for silver coins. The banker says "Pay by check," advancing some good reasons therefore. He is legally and lawfully advancing his interests. Pay by check restricts the use of coins, and, developed to its full extent, would close the silver mines, as sufficient would be produced as a byproduct in lead and copper smelting. Meet the banker halfway. Deposit your money in the bank, but when you change a five or ten dollar bill, say, "Silver, please!" It may wear out your pockets, but it will furnish money to buy new pockets. At home, ask the keeper of the family budget to keep the "petty cash" in silver, to pay all small bills in cash (silver). Tell the butcher, the baker, and the candlestick maker what you are trying to do. His good includes your good, for if you get a higher price for your silver you will have more money to spend with him.

Now, ask your representative in Congress to strive for legislation to limit Treasury notes and Federal Reserve bills to a ten dollar or higher denomination. Allow no legal tender below that amount except coins and Treasury certificates for coins. We do not question Uncle Sam's credit, but we are trying to sell silver. We are helping Uncle Sam to make money, for he will buy our silver at one dollar per ounce and he will sell it at from $1.29 to $1.35 per ounce as coins. That will give Uncle Sam a good profit.

Just remember to say, "Silver please!"

Albany, N. Y. JOHN F. LYON.

A Suggestion to the Independent Silver Producer

THE EDITOR:

Sir—I have observed your comments on the recent action of the Director of the Mint in accepting tenders for future delivery of silver under the terms of the Pittman Act and his ruling that when these tenders shall have reached the total amount of repurchases, the act will automatically become inoperative. You suggest that the situation of the "independent" producer that does not market his metals or bullion through one of the large smelting companies, who are the vendors of 95 per cent of the silver sold, is rather uncertain.

It seems to me that his course is clearly indicated. I should say that he ought immediately to prepare affidavits as to the domestic origin of the silver in the ores produced from his mine during the period from Jan. 17, 1920, until May 17, 1920, and immediately make formal tenders to the Director of the Mint of the quantity of silver therein contained. This is, of course, providing he has not already done so. As the date of the completion of the repurchases approaches, he should also, of course, make daily tenders to the Director of the Mint of silver contained in the ore that he produces from day to day. You will recall that May 17, 1920, is the date on which the world's price for silver fell below $1 and the repurchase provision of the Pittman Act became effective. At that time, it was agreed between the Director of the Mint and the smelting companies that silver taken from the mine after Jan. 17, 1920, should be salable by them under the terms of the act. This arbitrary period of four months was presumed to represent the average length of time consumed in smelting and refining the ores and preparing the silver for market. As a matter of fact, silver in many zinc ores is in the various processes of metallurgical treatment for from six to eight months; silver in cyanide ores may not be recovered for from thirty to forty days after the ore first reaches the crushing plant; on the other hand, the period might not be more than ten days. The length of time would depend upon the process used, whether leaching or agitation, and whether the precipitation was by zinc dust or zinc shavings. Silver-lead ores might not be more than ten days in a smelter when they are treated by roasting, blast-furnace smelting, and the Parkes process for refining the silver. The period of four months was arbitrarily fixed upon as being the average period in which ores are in process.

In considering this question, two facts should be borne in mind:

1. No attempt has ever been made to compel the vendor of silver to make any physical identification of the particular lot of metal that he was selling, whether with respect to locality or time of production. Silver that was actually produced in Peru during January, 1919, could have been sold as Pittman Act silver, provided it was accompanied by an affidavit from a miner

as to the domestic production of a similar quantity of silver and an affidavit from the smelter to the effect that he had received ore containing such a quantity and had begun or was prepared to smelt it in his plant. The affidavit merely established *quantity*, not *identity*.

2. The Pittman Act was a transaction between the government and the miners—that is, the original producers of silver. The smelting companies really had nothing to do with it, except that the ores usually passed through their hands. This fact is emphasized strongly in the recent conference at Washington, when it is pointed out that the priority of purchases is determined by the time at which the ore is taken from the mine, not the time when the metal is actually marketed. For convenience, the date of delivery to the smelter must be used, for the reason that ores are first weighed and sampled accurately when they pass through the sampling plant at the smelter, or on their way to the smelter. A comparable date with respect to ores milled in cyanide plants at the mine would be the date of delivery of the ore to the mill and its original sampling in the cyanide plant.

In view of these facts, it might be argued that there was no adequate reason for accepting affidavits covering silver mined during the four-month period just preceding the date on which the first purchases under the Pittman Act were made. Up to that date, May 17, 1920, all miners were on approximately the same basis. Those who had sold their ore to smelting companies had received the prevailing world's price for silver (subject, of course, to the deductions provided in their regular contract) and the small "independent" vendors had likewise marketed their silver at the world price, which prior to that time was more than $1 per ounce. A better plan might have been devised than accepting affidavits covering silver mined during the preceding four months.

Irrespective of the reason for establishing this policy, it seems to me that it should apply alike to every miner of silver-bearing ore. In other words, every miner should be allowed to sell at the Pittman Act price the quantity of silver contained in the ore that he produced between Jan. 17, 1920, and the date, hereafter to be established, at which the total repurchase shall have been completed. That, it seems to me, is the only fair and equitable way out of the problem, and the plan has the added merit of simplicity.

If all producers are treated exactly alike in this respect, the plan to accept tenders of silver for future delivery as outlined in the recent pronouncement by the Director of the Mint is entirely reasonable. The procedure will eliminate an economically wasteful race to convert silver-bearing materials at the smelters into marketable bullion and it will prevent a conceivable "line-up" of motor trucks carrying silver bullion to the mint in the final hours before the total repurchases shall have been completed.

A great many producers of silver cyanide bullion sell their product to such plants as the Selby smelter, in California, for refining. I do not doubt that many such companies have already delivered to the smelting company affidavits as to the production of silver in ores mined during the four-month period in the early part of 1920.

I should say that the independent producer, who has been accustomed to make his own bullion and ship it to the Director of the Mint, should proceed forthwith, if he has not already done so, to prepare affidavits in the regular form as to the domestic origin of the silver actually mined by him from Jan. 17, 1920, until May 17, 1920, and to tender to the Director of the Mint for future delivery a quantity of silver equivalent to the amount contained in that ore.

If there is no thought of trying to determine the actual identity of any bullion so sold, I do not see on what ground the Director of the Mint could discriminate between such tenders and the tenders that already have been accepted from the principal vendors for delivery of silver that presumably is now in process.

Salt Lake City, Utah. ARGENTUM.

Amount of Silver Used in Coinage

THE EDITOR:

Sir—The various discussions and studies of the silver situation recently published fail to show the very important fact that the amount of silver actually coined by the mints of the world far exceeded the amount of silver produced by the mines. Of course this means that a large amount of silver ware, ornaments, etc., was melted up and coined to meet the necessities of a war-stricken people. The figures are, however, impressive, amounting to a total of 1,746,758,000 oz. of silver coined in the seven years 1914 to 1920 inclusive, or 249,541,258 oz. annually minted, contrasted with a total production for this same period of only 1,220,400,000, or 175,500,000 oz. annually. This shows a shortage, for *coinage alone*, of 526,700,000 oz., and leaves the large amount of silver used in photography, silver ware, and the arts generally to be accounted for. As has often been pointed out, the silver market is, however, governed by the buying of India and China, whose buying power is largely a matter of good harvests; they are the real dominating factors in the "Silver Question." Nevertheless, the above-stated facts are worthy of serious consideration at a time when specie payments are needed, and even England has found it necessary to debase her currency. The figures given are those of the Director of the Mint. WALTER HARVEY WEED.

Tuckahoe, N. Y.

The Laws of Crushing

THE EDITOR:

Sir—In reading John Herman's article on "The Laws of Crushing" in the March 17 issue of the *Journal-Press* several points came to my mind. I do not disagree in principle with the deductions made by Mr. Herman, but simply want to point out the many ramifications to the general subject of grinding and how difficult it is to apply any law that will fit more than a few cases without requiring material alterations or many correction factors.

The Hardinge Company has often been asked to run tests on a few tons in an experimental mill. We usually find, however, that such experiments mean little or nothing, for the conditions of a test are generally far different than those found in practice.

We have tried for a number of years to work out some formula which would aid in determining what would happen under certain given conditions. Today, after having analyzed the results of more than 500 different operations, both from a technical and practical standpoint, we still feel much at sea when attempting to lay down general rules to follow. Inasmuch as the up-to-date engineer dislikes empirical formulas, the only

real way to estimate closely what may be done under given conditions is to interpolate the results of similar operations, and modify the figure so determined, according to our best judgment.

The following are a few of the factors which must be taken into consideration when predicting the probable output of a ball mill under given conditions:

First, what is the capacity per unit going to be? As a general rule, it is found that the greater the capacity per unit, the greater is the efficiency of grinding, although this does not necessarily hold true for certain materials.

Second, what character of material is to be ground? Even materials of apparently the same physical characteristic sometimes vary 50 per cent in their resistance to grinding. Even some ores taken along the same vein and in the same property change to a surprising degree.

Third, the size of the material going through the mill is an extremely important factor, for unless the grinding media are so adjusted as to break the coarsest feed on the first blow, the operation will be far from efficient; on the other hand, if the blow is too great and either overgrinds the material or expends unnecessary energy, wearing out the grinding media and lining, the efficiency is again reduced. Theory or no theory, practice has shown almost without exception that so far as efficiency of grinding is concerned, step reduction, either within the mill itself, or in a series of mills, has proved most economical, although the initial outlay of equipment is sometimes more than conditions would warrant, especially in plants of small capacity.

Fourth, the character of product desired is another extremely important point. Here, again, step reduction is a factor. Capacity is greatly dependent upon the final reduction necessary and the amount required through a given mesh. Some materials break down readily to a given size, say 48 mesh, being hard to reduce below that point. Other materials possess just the opposite characteristics. This factor is largely dependent upon the structure of the particle.

Fifth, is the grinding to be wet or dry? The operation of a mill grinding wet is considerably different from that when grinding dry. When grinding wet the material is "lubricated," one might say. Again, the water tends to float out the fine material from the coarse. On the other hand, the dry material tends to remain in one place longer, and thereby is more likely to be struck rather than have the grinding media work on too thin a mass, as often happens in wet grinding. The moisture content in grinding dry is just as important as when grinding wet. A material which is bone dry flows readily, but when carrying from 3 to 10 per cent of moisture, depending upon the material, it tends to pack, becomes inert, and seems to resist grinding to a much greater degree. One of the empirical formulas which applies to a few cases is that for every per cent increase of moisture content from a bone-dry state, efficiency of grinding decreases 10 per cent, up to 5 or 6 per cent; then the effect of moisture is even more pronounced, and finally the grinding ceases altogether somewhere between 8 to 15 per cent, again depending upon the class of material being ground. The effect of this moisture on the fineness is difficult to predict, as so many factors come into play, but, generally speaking, an increase in moisture decreases the fineness when the capacity is held constant.

When grinding wet, more uniformity of operation is noted, although here again the results obtained from the same size of mill operating under apparently similar conditions often give diametrically opposite results. For instance, I have in mind a 6-ft. x 22-in. Hardinge ball mill which gives maximum fineness at a moisture content of about 33 per cent, whereas another mill of the same size with approximately the same ball load on a property not one mile away grinds to the same fineness, operating at the same speed, but the moisture content must be kept at about 52 per cent to obtain maximum efficiency. None of the other factors were different to any appreciable degree. The superintendents of both plants are men of high caliber and much interested in the theory of grinding, and they have done a great deal of experimental work, and exchanged ideas. But with all this, the results are as stated.

Sixth, what shall be the speed of the mill? This determines not only the number of impacts per revolution, but the amount of energy exerted per impact. When the mill is speeded up, the balls, instead of rolling down the incline, hitting many points, will either hit no point except that at the bottom, or will hit just a few on the way down. Offhand, one would say that a higher speed would be best for coarse crushing, for then the entire energy would be exerted at the bottom, and not distributed all the way down; and that for fine grinding the speed should be slow, so that the balls would roll rather than cascade. This is true to a degree, although the results often seem to be contradictory.

Seventh, the ball or pebble load is one of the most important items of all, for it is the proper adjustment of the sizes and quantity of grinding media which affects not only the capacity but the fineness. The action of the balls is that of both impact and attrition. The impact usually occurs near the surface of the pulp, or where the balls roll or fall down the incline, whereas the attrition occurs mainly within the mass, for when the mill is rotating and the entire mass is raised on one side, there is an internal movement in the mass of balls and pulp. The grinding which results is purely attrition, and, as a consequence, the greater the diameter the greater is the grinding effect. The inherent advantage of a short length but large diameter is thus evident. The charge of balls with respect to the mill size must also be coupled with the number of cycles that the charge will complete during each revolution. For example, if the mill were charged exactly half full, and no slipping occurred within the mill, except at the surface where the balls and material run down the slope, two cycles would be made for each revolution. If this ball charge is reduced so that the charge covers only one-third of the shell, then, theoretically, three cycles will be made for each revolution. I say theoretically, because actually, due to the internal slip, such is not the case, but this illustrates the point. When there is an increase of ball charge, giving more grinding mediums and greater superincumbent weight to do the effective grinding, the number of cycles per revolution is reduced, and consequently the number of blows per ball per revolution is also reduced. Thus one condition tends to counterbalance the other.

In many mills such as those at the McIntyre-Porcupine Mines Co. a lower ball load gives better results than the theoretically correct charge; in other mills such as those at the Miami Copper Co., loading the Hardinge mills as much as 6 in. above the center line gives the best over-all efficiency. The choice of the size of balls and the weight of the total charge depends upon

the hardness and maximum size of the pieces undergoing reduction. As is generally known, the larger the pieces being crushed the larger must be the size of ball. On the other hand, increasing the diameter of balls decreases the number of balls which can be put in the mill for a given weight, and consequently reduces the number of points of contact. Conversely, a smaller ball will allow more balls to be used, and more points of contact will result. The proper selection of the ball charge and proportioning of the ball sizes for the character of grinding to be done is a subject which can well be considered a specialty in itself, and no amount of theory has yet been able to apply a formula which would meet this situation, except only in the simplest cases.

Eighth, the nature of discharge is important, for it determines the rate of removal of the finished or semi-finished material from the mill. Theoretically, it is best to remove the ground material just as soon as it is ready or finished. Practically, however, to do this would necessitate a mill with an infinite number of screen openings which would not clog, but would remain free enough to discharge all material as soon as ground. On the other hand, if this were done, what would happen to the grinding media? Would there be enough cushioning effect of the semi-ground material left to prevent excessive wear? Here is a serious factor which must be taken into consideration. The ordinary forms of ball mills discharging through the trunnion do not attempt to remove only the finished material, but allow some of the oversize to be discharged from the mill along with it.

If such a mill is to be operated in open circuit, the amount of oversize must be kept down, but if in closed circuit a high circulating load is advisable, as has been thoroughly demonstrated by the operation of the conical mills in the test plant of the Mesabi Iron Co. I should say "thoroughly demonstrated on the particular iron ore as run through this mill," for although it was definitely shown that this high circulating load greatly increased the efficiency of operation for this material. we have no right to assume that the same will be true for every other material. In fact in every case so far recorded where the operation has been carried out in accordance with good practice, the high circulating load has universally shown an improvement. This discharge effect is extremely important in dry grinding, for here there is no water to help the product discharge from the mill, and the operator must rely entirely upon its natural flow.

Additional factors might be mentioned, but I believe the ones outlined are considered the more important.

Some time ago I figured out, to satisfy my own curiosity, how many tabulations would have to be made if a capacity table were to be devised covering only the every-day requirements in grinding, and not the numerous special cases. Such a table would contain 66,000 tabulations! HARLOWE HARDINGE.

New York, N. Y.

Ore Horizons at Cobalt

THE EDITOR:

Sir—Judging from the article, "The Overestimation of Geological Skill," in the March 24 number of the *Journal-Press*, it would seem that the writer assumes that because there is no zone of "secondary enrichment" in the Cobalt district it would be impossible for a geologist to "correctly calculate the depth of enrichment" at any of the mines in that district. I am not sufficiently familiar with the mine to which he refers to state definitely that such a calculation could be made in that case. I should like, however, to cite a case in the Cobalt district where the zone of enrichment has been proved to lie within a definite distance above a certain contact between two geological formations and where exploration work was directed to within these limits with satisfactory results.

At the mine to which I refer the oldest geological formation, the Keewatin, consisting of much altered diabase, greenstone, etc., is overlaid with the Huronian conglomerates, slates, and quartzites. Both of these formations have been cut and probably covered by a disbase intrusion in the form of a sill, most of which has been eroded, leaving the Huronian exposed. After a certain amount of exploration and development work had been done, it became evident that the only section of the veins to carry "pay ore" extended from the Keewatin-Huronian contact for a distance not exceeding 100 ft. into the Huronian. As soon, therefore, as the position of this contact was known, operations were confined to within this limit, with entirely satisfactory results.

Experience also proved that the character of the ore varied with the nature of the Huronian formation; The veins in the coarse-grained conglomerate, containing large pebbles or boulders of granite, quartz, etc., were well defined and regular, usually high grade, and carried the value in the vein itself. In the slates the veins were small and irregular—often several parallel veins or stringers with native in the wall rock for a distance of several feet on either side of the veins, so that the stopes in this formation were often more than 20 ft. wide. In the fine-grained conglomerate and quartzite the veins were usually narrow and low grade, with little silver showing in the wall rock.

I think you will agree with me that a geologist familiar with such conditions at one mine is in a position to direct operations at other mines where the geological formation is similar, with a fair chance of success. Should these operations lead to the discovery of pay ore, "geological acumen" should receive some of the credit due, as well as "luck and pluck and common sense."

I should like to add that the case I have cited is not an isolated one, but that the same conditions apply to many of the mines in that district, including some of the largest producers. Although the zone of enrichment is limited vertically, this is made up for by the great number of the veins, most of which are high grade.

As the Keewatin-Huronian contact is fairly regular, its approximate position may be estimated over a considerable area, when only a few points on it are known and the principle is applied during the early stages of the development of the mine. In the case to which I refer, however, it was decided to locate the contact over an extensive area (about 300 acres). Numerous diamond-drill holes were put down from the surface and from the underground workings to cut the contact and to determine the nature of the Huronian formation, and from the data thus obtained a contour map was made of the upper surface of the Keewatin. Later a clay model was made from this map. As practically all the mine workings were above the Keewatin, they were made to scale from material suited to the purpose and placed in position on the model. JOHN W. SHAW.

Annapolis Royal, N. S.

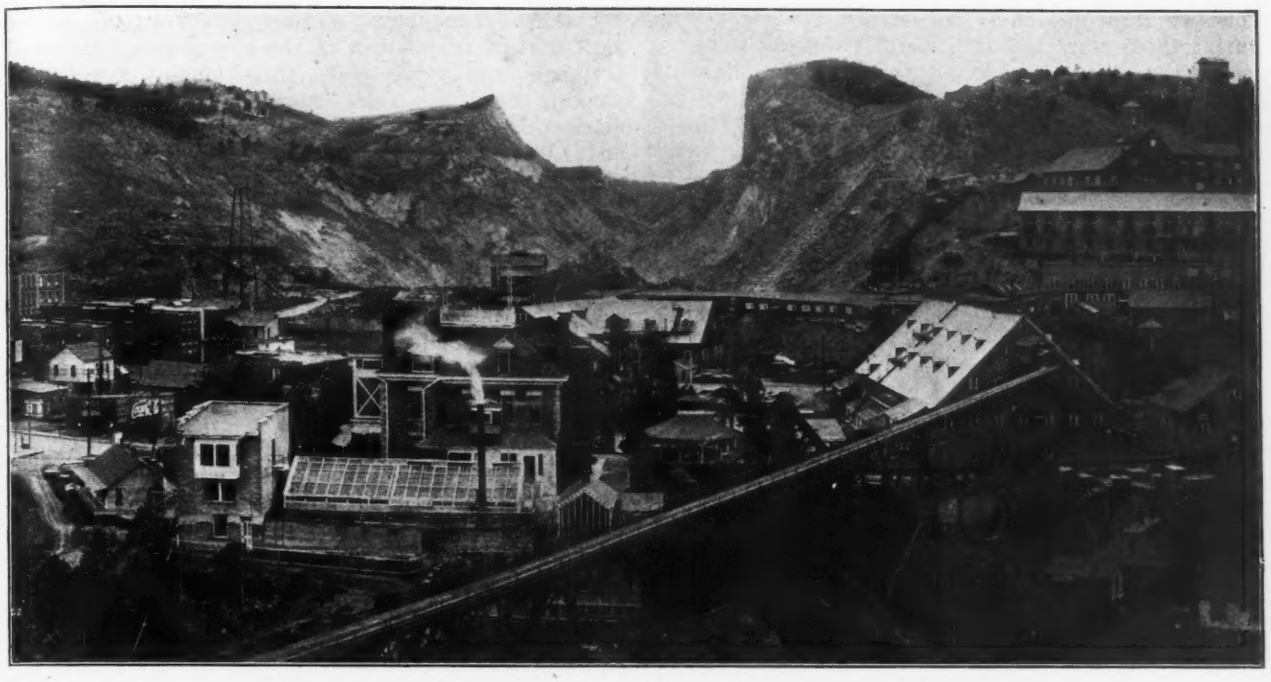
Metallurgical Engineers of Note

LAWRENCE ADDICKS

THE PURPOSE of this page is to shed as much light as possible on the question, "What manner of man is this person Lawrence Addicks?" To that end we have adorned it with a portrait that is at least a fair likeness of him as he appears today. Before proceeding with what the cinema people call "human-interest stuff"—necessarily the most illuminating part of the sketch—we will devote a few of the 714 words (count them) that the page holds to a statistical résumé of his career. Born in Philadelphia, March 3, 1878; graduated from M. I. T., June, 1899; married, June 20, 1899; draftsman for Santa Rita Copper Co., 1899; assistant to the superintendent Raritan Copper Works, 1900-1905; chief engineer De Lamar's Copper Refining Co., 1905-1906; superintendent U. S. Metals Refining Co., 1906-1914; consulting engineer, 1914 to 1923; author of "Copper Refining," a standard book on the subject; since 1915, a member of the U. S. Naval Consulting Board. Member of numerous clubs and technical societies. M. I. T. courses have a reputation for being pretty stiff, but Mr. Addicks absorbed all that was offered in both electrical and mechanical engineering in four years. Ten days after graduating he established the firm of Addicks & Addicks, the other member being Mary Maulsby O'Brien, and departed for New Mexico, where he took his first job at $75 per month as general-utility man for the superintendent of the Santa Rita Copper Co., where a number of lessees were gouging rich copper ore from the ground that is now being steam-shoveled by the Chino Copper Co. Mrs. Addicks, who has always been business partner, guide, philosopher, and friend to her husband, made the first home of her own in an adobe hut at Santa Rita. In the course of a year nothing of particular value developed at the New Mexican prospect, and the young couple returned East. Next Mr. Addicks accepted a job at the newly built Raritan Copper Works, which had a refining capacity of 12,000,000 lb. of electrolytic copper per month. Mr. Addicks bows low to Lady Luck—we suspect he accords her too much credit, in fact—for landing him in this position. This first big plant of its kind was built largely on an empirical basis, nobody in those days having any definite idea of the exact whys and wherefores of what transpired in the electrolytic vats. Young Addicks, as assistant to the superintendent, was turned loose to study the electrolytic deposition of copper; and study it he did. He has been studying and applying the results of his study ever since. He disclaims knowing all there is to know about it now, but most of those who have copper to refine seem to think that he knows a little more than anybody else. That is the reason that he is consulting engineer for the American Metal Co., for the Cerro de Pasco Copper Co., for a Belgian company that is building a refinery near Antwerp for the treatment of Congo copper, and for a Spanish company that has just started a plant at Cordova to refine cement copper. In 1918, the "firm," in the dual capacity of member of the Naval Consulting Board and consulting engineer for the Burma Corporation, went around the world. It mixed lead-zinc metallurgy with government diplomacy and had a good time in—among other places—China, Japan, India, Gibraltar, Egypt and London.

LAWRENCE ADDICKS

Keen, competent, and successful engineer though he is, many who know him best contend that Mr. Addicks should never have followed so prosaic a career. They think he should have developed his latent artistic talent as a musician, a painter, an actor, or a writer of fiction. If not this, they say he should have studied law; then he could have become a politician, then a statesman, and then in due course a habitual, instead of a casual, after-dinner speaker. Those who attended the banquet of the A.I.M.E. at the Waldorf on Feb. 17, 1920, at which Mr. Addicks was toastmaster, can appreciate the reason for this. We should like to—but cannot—reproduce page 502 in the *E. & M. J.* of Feb. 21, 1920. There appears conclusive evidence that one of the consummate after-dinner roasters of all time is "wasting" his genius building copper refineries. Seriously, Lawrence Addicks is one of those rare men who have both the ability and habit of doing exceptionally well anything that they undertake; he is one of the really brilliant men in the profession.



View of part of Lead and Homestake surface plant. Note open cut

Geology of the Homestake Orebodies and the Lead Area of South Dakota—I

The Formations Found in the District—Mineralogical and Structural Features, With Their Relation to the Deposition of the Gold and Associated Metals

By J. O. Hosted and L. B. Wright*
Geologists, Homestake Mining Co., Lead, S. D.

THE HOMESTAKE MINE is situated almost in the city of Lead, which is in the northern Black Hills of western South Dakota. The underground workings extend northwest from the Ellison shaft, on the south slope of Gold Run Gulch, to the south slope of Deadwood Gulch opposite Central City. The northwestern part of the workings represents the earlier seat of operations and is a source of production at present through the open-cut mining operations. The underground mining is now confined mostly to that part of the workings nearest Lead.

More than two years have been spent by the writers of this paper in studying and mapping the orebodies. A detailed description of the methods used in this work appeared in the Dec. 3, 1921, issue of the *Engineering and Mining Journal*.

Brief History of the Mines

For some time previous to 1875, rumors of gold in the Black Hills reached prospectors in other districts, but owing to the treaty then existing between the government and the Sioux Indians, who held the hills as their reservation, several attempts by white men to penetrate the promising area were discouraged by the government. However, in 1875, under the authority of the Secretary of the Interior, a protected party which included W. P. Jenney and Henry Newton, geologists, visited the hills, but confined most of their investigations to the southern part and did not reach the Lead district.

Two prospectors, Frederick and Moses Manuel, are said to have discovered the Homestake orebody at a point where the south end of the open cut is now situated. This was in April, 1876, and the Highland and Golden Star claims were located later in the same year. Owing to the vegetal growth and talus, it was not possible for these pioneers to recognize the magnitude of their discovery or the geological relations of the various outcrops.

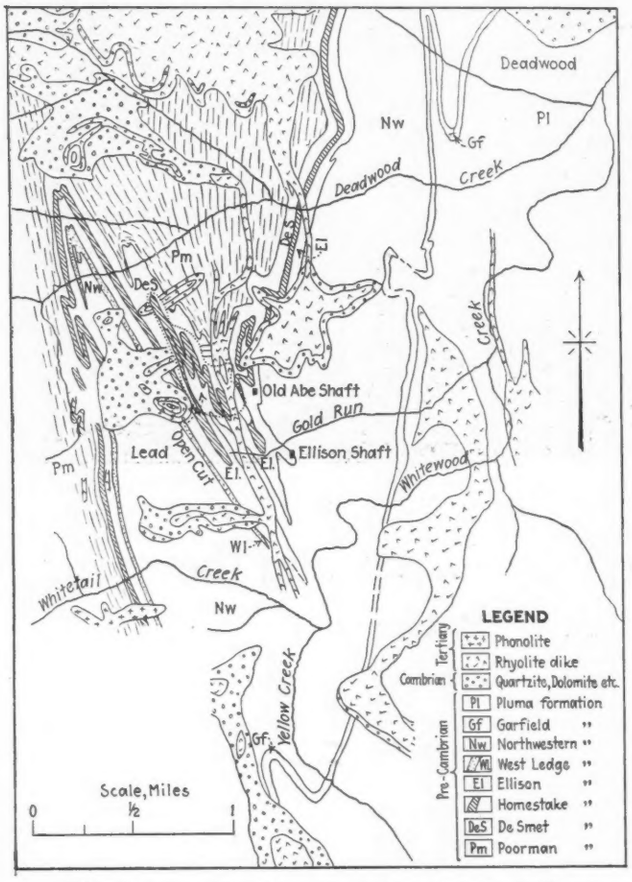
In 1878 four companies, the Homestake, Father De Smet, Highland, and Deadwood Terra, were organized and developed their holdings. Not long afterward, they were operated under one management and ultimately came to be the Homestake Mining Co. through acquisition of the adjoining claims by the original Homestake. The old names as they apply to the different parts of the orebody are still in use.

The development of the property up to 1885 was under the superintendency of Samuel McMaster, who was followed by T. J. Grier, to 1915, Richard Black-

*The writers of this article express their sincere thanks to B. C. Yates, superintendent of the Homestake mine, and to R. G. Wayland, assistant superintendent, for the opportunity of making this study; to J. D. Johnson, assistant chief engineer, for criticism of much of the manuscript; and also to Sidney Paige, of the U. S. Geological Survey, for many helpful suggestions. The photographs were lettered and many of the tracings made by K. D. Pyle, of the engineering department of the Homestake. Photographs and photostats were made by A. Lease, of the engineering department.

stone, to 1918, and B. C. Yates, to the present time. During these years and until now the annual production has increased in the face of the great handicap of increased operating costs. The workings have continually gained in depth without a falling off in the tenor of the ore on the lower levels.

An 1,800-ton mill is being put in operation, which,



Sketch map showing general geology of the Lead district

when running under favorable conditions, will probably exceed its designed capacity. The total tonnage treated in 1921 was 1,620,588, yielding an average of $3.89 in gold per ton.

The relief of the district is marked, ranging in elevation from 4,700 to 5,725 ft. above sea level. Terry Peak, five miles southwest of Lead, has an elevation of 7,071 ft., the highest peak in the northern Black Hills. The region comprises prominent hills, ridges, and broad gulches, many of which are forested with pine.

Most of the hills are easily accessible, but in the section south of the Homestake workings, along the north side of Whitewood Creek, the hills and ridges are steep. The diorite porphyry stock in the northwest part of the district is also precipitous. Many of the hills and ridges have their longest dimensions striking northeast, their length in many cases being about three times the width, or about 3,000 ft. long and 1,000 ft. wide and reaching from 260 to 700 ft. above the creeks. Rhyolite usually caps the hills, and in many places the long narrow ridges are composed of quartzites.

The outstanding topographical feature of the area is an artificial one—namely, the main Homestake open cut, which is about 4,400 ft. long and ranges in width from 50 ft. at its northern end to 1,000 ft. at the middle. It ranges in depth from 50 to 450 ft. More than 20,000 cu.ft. of rock is removed from the walls and bottom daily.

Five months of winter, two of spring, three of summer, and two of fall classifies the climatic conditions. The winters are long but mild, with considerable snow. The spring months are usually cool and moist. Heavy snowfall is common in May. The summer months, especially July and August, are delightful, with warm sunny days and cool nights. Early falls are cool and pleasant. Cold weather and much snow can be expected during November. The snowfall for the year is considerable and aids toward furnishing a sufficient water supply during the summer months. Tie-ups on railroads due to climatic conditions during the winter months happen rarely and must be endured for only a day or two at the most. Hard windstorms are exceptional.

Pre-Cambrian Record

The oldest rocks outcropping in this area we believe to be of Archæan age, and belonging to the Keewatin series. An estimate of the thickness of this series is approximately 20,000 ft. The rocks are quartz-mica schists, garnet schists, quartzites, slates, and phyllites; and green schists probably derived from basic igneous rocks. There are also beds of dolomitic limestone, considerably altered as a whole but in places remarkably fresh considering their age. Regarding the entire series, however, the dolomitic limestones constitute only an insignificant proportion.

The series has been subdivided locally on a lithologic basis into several formations. This has been done in connection with our study of the Homestake deposits merely as an aid in correlation and is not intended to apply to outlying districts. (See table below.)

General Character and Distribution

Poorman Formation—The exposures of this formation are mostly in the west, northwest, and northern parts of the district. At the junction of Poorman and Deadwood gulches, along the railroad track, a good section of this formation is exposed. Carbonaceous, banded mica schists and slates are the most abundant

Geologic Formations		Thickness in Feet
Pluma Formation	Alternating beds of garnet schist and carbonaceous slates, some of which are pyritiferous	4,000
Garfield Formation	Banded, fine grained, cherty ferruginous quartzite; black and red bands; pyritiferous;	
Northwestern Formation	locally known as the Iron Dike; contains some carbonates	60
	Green, finely foliated garnet mica schists and quartzites	2,200
West Ledge Formation	Siliceous dolomitic limestone; chloritic; grading to impure calcareous phyllite	100
Ellison Formation	Quartzite: massive, hard, medium grained; interbedded with quartz-mica schist	300
Homestake Formation	Cummingtonite and chlorite beds, with contorted quartz stringers; constitutes main ledge series; in places, dolomitic	70
De Smet Formation	Garnet schist; alternating light and dark bands; micaceous, fibrous, thinly foliated	300
Poorman Formation	Slates and phyllites; calcareous, graphitic, pyritiferous	2,500
Total thickness		9,530

rocks. They vary in color from light gray to dark gray, and are fine grained. The mica is chiefly muscovite. Some of the slates and schists are graphitic and pyritiferous. The pyrite is chiefly confined to the carbonaceous rocks. There are many narrow quartz stringers. Some are parallel to the bedding, but many cut the bedding at various angles. All of the rocks are schistose and tightly folded. The quartz stringers are much contorted and indicate tight folding; they are apparently of pre-Cambrian age. There is considerable cross-jointing. A few beds of garnetiferous schist are interbedded with this series. The upper part of the Poorman formation grades into the De Smet formation.

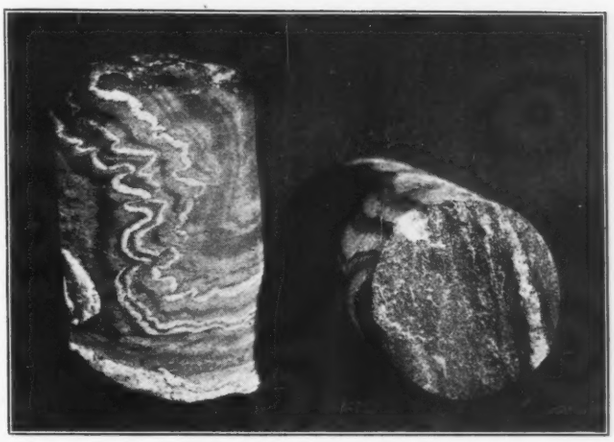
De Smet Formation—Exposures of the De Smet formation are plentiful around the north end of the main open cut, southwest of the De Smet shaft. The most striking characteristic of the formation is the abundance of small garnets. Most of the garnet schist is green to dark gray; the green is due chiefly to chlorite. The schists are finely foliated and appear bumpy, due to the garnets, which are seldom exposed along the schistosity and almost invariably are concealed by a thin layer of chlorite. Locally there are thin films of pyrite parallel to the schistosity, and in many places the rocks have crenulations, the majority of which trend across the schistosity, indicating two periods of folding. The transition to the Homestake formation is sharp and distinct.

Homestake Formation—This formation is easily distinguishable from all others in the series. Its outcrops are usually red and massive. The red color is due to the oxidation of the ferruginous minerals. The original formation was a siliceous, ferruginous, dolomitic limestone, somewhat banded and in places well preserved. The greater part of the bed is now cummingtonite schist. This almost complete recrystallization undoubtedly took place contemporaneously with the folding. In some places the cummingtonite schist is altered to chloritic schist, this alteration probably taking place during the second period of folding (Algomian Revolution). The bunches of cummingtonite crystals vary in length from one-half inch to one inch. Some are flattened out along the original bedding planes and others cross the bedding at various angles. In some instances the bedding is preserved and in others it is not perceptible.

The formation is tightly folded and compressed and in a few places entirely pinched out. Most of the cummingtonite is black, though some is gray to green. Reddish brown garnets of the andradite variety occur irregularly. The formation is also characterized by quartz lenses and knots of various sizes.

Ellison Formation—The Ellison formation overlies the Homestake formation and is characterized by its hard, medium-grained, ridge-making quartzites, some of which contain flakes of biotite. In many places they are fractured and appear as disconnected blocks. Under stress, the quartzites broke more easily than they bent; and the mica schists between them in some cases flowed around the broken ends of the quartzite blocks. Good exposures of the formation can be seen on the road to the mine office and Ellison shaft.

The quartzites are usually between ten and thirty feet thick. They seldom contain sulphides. The mica schists are gray in color and quartzose; the mica is mostly muscovite. Above the quartzites and mica schists are found garnetiferous chloritic mica schists.



Folded pre-Cambrian stringers in the Poorman formation

West Ledge Formation—This formation is represented by gray-green, dolomitic, chloritic, siliceous, banded beds containing some cummingtonite. Weathered outcrops are usually red in color, due to oxides of iron. The series grades into banded, fine-grained, calcareous slate. Mineralization of the West Ledge formation has occurred locally, the type being similar to that in the Homestake formation but less complete and intense; however, at a few places it constitutes ore. It also contains much white quartz, in which ankerite is found. Similar white quartz and ankerite occur in the Homestake formation. This formation, like the others, is folded. Crystals of dolomite are prominent and can be recognized easily. The beds of the West Ledge are much more siliceous than those of the Homestake formation, which fact explains, perhaps, the lower value.

Northwestern Formation—The Northwestern formation is so named because it is best exposed in the railroad cuts of the Chicago & Northwestern R.R. between Lead and Blacktail. It is essentially a green garnetiferous schist that is finely foliated. These garnetiferous beds are interstratified with thin micaceous quartzites. The formation contains little or no sulphides. Outcrops are usually green and show close folding. A thickness of 2,200 ft. of nearly uniform

Low plunging anticline, west ledge, 900 level, Ellison formation

material suggests that conditions for accumulation were constant for a fairly long period. Only a few short, rapid changes must be inferred to account for the presence of the thin micaceous quartzites. The garnets are of the same size and variety as those occurring in the other formations. The contrast between the Northwestern formation and the underlying and overlying formations is distinct and sharp. It contains few quartz stringers or lenses and is less resistant to erosion than are the others.

Garfield Formation—This formation is far removed in general appearance from the others. It is prominent as a ridge maker and resistant to weathering actions. It is locally known as the Iron Dike, because of its iron content and long, dike-like outcrops. It is the thinnest formation of the series, and is essentially a hard, fine-grained, banded, ferruginous, cherty quartzite containing some carbonates. The bands are black and red and about an inch in width. In many places it is highly pyritiferous and has been mined for the iron sulphides. Graphitic schists lie usually immediately above the quartzite and are also pyritiferous. In places the sulphides have been oxidized to sulphates, producing outcrops of yellow-ocher color. The quartzite resembles certain phases of the iron-bearing Soudan formation of the Vermilion Range of Minnesota.

Pluma Formation—The uppermost formation in the district can best be studied at Pluma, about a mile and a half east of Lead. It is principally made up of an interbedded series of green garnetiferous schists and carbonaceous clay slates. The green schists are micaceous and chloritic and usually finely foliated. Some garnets are about the size of a pinhead; others vary from this size up to an eighth of an inch in diameter. The clay slates are gray-black and fine grained and in places pyritiferous. The pyrite is usually in thin veinlets. The thickness of the clay slates exceeds that of the schists. The total thickness of both slates and schists is about 4,000 ft., this constituting the total thickness of the formation in the district.

There are other formations above the Pluma formation and they may be a continuation or repetition of the same rocks due to folding, but inasmuch as they lie outside of the area under discussion they have not been studied in detail.

It is estimated that the Keewatin series in the northern hills is 20,000 ft. thick and the total thickness of the eight formations in the Lead district is approximately half this figure.

The Amphibolite (Keweenawan Series)—This series intrudes the formations of the folded Keewatin series. There are two classes of dikes based on color alone, the green basic dikes and the dark-green basic dikes. The green ones predominate, some having a diabasic texture. The coarse-textured dikes of both classes resemble pyroxenites and gabbros. The darker dikes are medium to fine grained and may be classed as dolorites. A few display a poorly and faintly developed schistosity. The green amphibolite dikes are easily recognized in this district by their lack of schistosity and their coarse texture and mottled appearance. They are lacking in sulphides. The dense black dikes, however, have some sulphides, but never in appreciable amounts. One contact zone between the mottled green dike and schist contains garnets of considerable size. The majority of the dikes are about 50 ft. wide.

Only the base of the Cambrian formation remains in this area.[1] It rests unconformably upon the upturned Keewatin formation and Keweenawan intrusives. The Cambrian formation is often capped by porphyry and in many instances contains the porphyry in the form of sills and dikes. The lowest member of the base is usually a conglomerate, which averages about 12 ft. in thickness. This conglomerate is made up of rounded white quartz pebbles, several inches in diameter, and fragments of pre-Cambrian rocks. The cementing material is usually found to be silica, carbonate, and limonite. The portions of the conglomerate that have limonite for cementing material are usually auriferous. The limonite was probably derived in part from sulphides, which were introduced at the time of or immediately following the rhyolite intrusion, replacing the original cementing material. Developments in the conglomerate are known as the "cement workings," which are to be found on the ridges north, east, and west of the main open cut. They have long ago been abandoned.

Directly over this basal conglomerate is usually a medium-grained quartzite, upon which rests a ferruginous dolomite, which in turn is capped by shales. The dolomitic bed immediately above the quartzite is the principal ore horizon. Smaller and lower-grade oreshoots have been found above. The ore deposits in the Cambrian are replacements of the calcareous and dolomitic portions, the solutions ascending through fissures in the underlying rocks. The age of these orebodies we believe to be the same as that of the Homestake and West Ledge formations. The fissures through which the mineralizing solutions passed were narrow and are now represented in the pre-Cambrian rocks by thin pyrite zones which are considerably oxidized. Much of the ore of the Cambrian is refractory and will not yield its values to the ordinary processes of amalgamation and cyanidation. The dolomitic bed just above the basal quartzite is sometimes called the "lower contact," and varies in thickness from less than a foot to ten feet. Values are variable, the average being much higher than that of the Homestake ores. The oreshoots are variable in size and are always found in conjunction with rhyolite dikes and sills. The sills usually occur as a capping of considerable thickness. The fractures through which the mineralizing solutions passed are known locally as "verticals." This term is often confused with the term "vertical formation."

Tungsten ore occurs on the west side of the main open cut and is found in flat irregular lenses about one and one-half feet thick and of variable horizontal dimensions. The mineral is chiefly wolframite (tungstate of iron and manganese). The ore is found directly above the basal quartzite. Good gold values occur with the wolframite and often pay for the mining and milling of the tungsten.

The company's tungsten workings have been idle since the end of the World War, the market being low.

Tungsten minerals have been found in the fractures in the rhyolite. The wolframite ores are also replacement deposits. Some silver minerals and galena also occur in this formation, but not in large quantities in this district.

[1]We have done no detailed work on the geology of the Cambrian formation. The work that has been performed was carried on to the north and southeast of Lead and just west of the Homestake open cut. These examinations were made primarily to gain information concerning the underlying pre-Cambrian formations. Next summer (1923) a complete examination of this formation is contemplated.

Most of these conclusions are in agreement with those of the late J. D. Irving and others who have studied this region and found the ores in the Cambrian formation to be of the replacement type.

Tertiary Intrusives in Evidence

Data from surrounding districts showing that the intrusives of the type found in this locality cut Cretaceous beds, together with the fact that in this district remnants of these porphyries are found in the White River formation of Oligocene age, place the age of the rhyolite and porphyry in the early Tertiary or Eocene. The rhyolite porphyry predominates, the other types being quartz porphyries, diorite porphyry, and phonolite porphyry. All of these types grade into one another. The intrusion of these porphyries caused no great disturbances, no great faulting or folding of the intruded rocks being in evidence.

The rhyolite caps many of the hilltops. In the Cambrian formation it occurs as sills and dikes, and in the Homestake mine only as dikes. The occurrence of the rhyolite in all the above-mentioned formations can best be observed in the main open cut. Here several parallel dikes can be seen in the tilted rocks of the Keewatin series. When the dikes reached the flat-lying Cambrian sediments they followed the bedding and became sills, some penetrating the thin upper shales and forming a capping. In the mine they strike parallel to the pre-Cambrian rocks (N. 40 deg. W. to N. 25 deg. E.) and dip with them steeply to the east. They average approximately 40 ft. in width, the number varying from three to seven. The wide dikes often split and make two or three smaller ones. The average total width of all the dikes in the mine is 285 ft. They thin out to the north and to the south of the mine workings. The rhyolite is fine grained and dense, being composed essentially of small crystals of orthoclase and quartz. Throughout the groundmass are disseminated small crystals of iron sulphides, pyrite predominating. Much pyritization and silicification at the contacts is usual, and the contacts are also characterized by flow structure. Coarse intrusive breccias, as shown here, often occur along the contacts. Sometimes the breccia is found entirely in the rhyolite and rarely in the country rock several feet from the dike. The breccias vary in width from an inch to one foot. The light-colored angular fragments are usually rhyolite; fragments of quartz are rare and always small. The matrix is generally dark, fine grained and siliceous, containing much finely ground country rock. The breccias also contain small disseminated pyrite crystals, which are fresh in appearance and of perfect crystallization. They are undoubtedly contemporaneous with the intrusion. Samples of breccia and rhyolite assay the same, usually 20c. in gold per ton.

In the rhyolite on the lower levels, fracture filling composed of calcite, galena, and pyrite assayed $1.85 in gold per ton. Large open fractures and watercourses contain pyrolusite and siderite, along with some tungstic oxides and only a trace of gold. These large fractures are at about right angles to the small ones mentioned above as containing galena and pyrite, and do not occur in the same part of the mine. The large open fractures have their strike parallel to that of the rhyolite. Northeast of this district and southeast of Deadwood, fractures in the rhyolite porphyry have been observed showing free gold, but these are rare and narrow.

Quartz porphyries occur along the Chicago & Northwestern R.R. between Lead and Blacktail. A dike 270 ft. wide is exposed in the most northerly northeast crosscut on the 800 level of the mine. Evidence of gold-bearing solutions having accompanied the quartz porphyry intrusion have not been found or suggested, although pyrite is present in the porphyry. The quartz porphyry dike strikes parallel to the rhyolite dike.

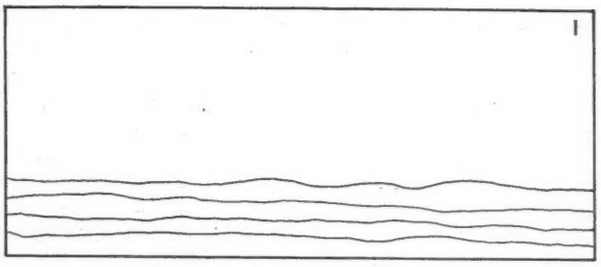
The quartz porphyry of this district contains large phenocrysts of usually purplish quartz averaging about one-tenth of an inch in diameter. The phenocrysts make up about one-seventh of the rock. The orthoclase is white and in small, lath-shaped crystals. The groundmass of the porphyry is not so fine grained and dense as that of the rhyolite.

In the northwestern part of the area, one-half mile west of Poorman Gulch and along Deadwood Creek, is a steep and rugged ridge of quartz-diorite porphyry. The rock is gray in color, containing light-gray crystals of plagioclase and quartz and large crystals of hornblende. The plagioclase crystals predominate. Small crystals of pyrite are disseminated throughout the mass. Large fractures are frequent, but have no definite system.

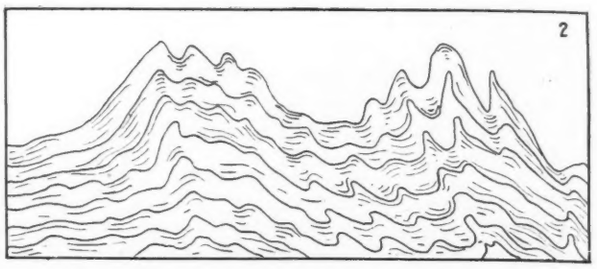
A coarse intrusive breccia found on the 600 level

Gold and silver prospects are found on many of the mineralized fractures. We have taken samples from many fractures in this diorite mass, but with no encouraging results. Assays showed no silver values and the highest gold value reported was only 50c. per ton. Other prospects, tunnels, and shafts have been driven and sunk in the quartz diorite masses of this northwestern area, and though the dump rock nearly always contains considerable pyrite, it does not contain sufficient gold or silver to constitute ore.

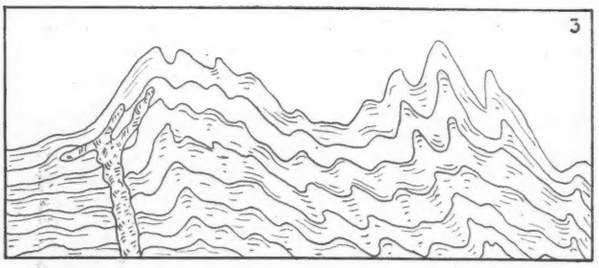
Exposures of phonolite porphyry are best seen in the southwestern part of this region. Here it occurs as a grayish green, flaggy capping, extruded upon the pre-Cambrian schists and slates. The thickness of the capping is from 10 to 60 ft. The rock is coarse grained, with large orthoclase and aegirite crystals. The presence of sulphides is infrequent.



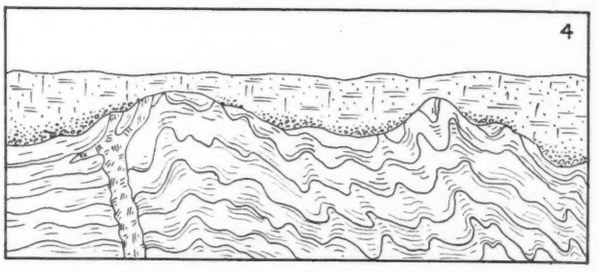
The six principal steps in the development of the Homestake deposit are indicated in these structural diagrams. The above figure shows pre-Cambrian (Keewatin?) sediments in position as they were deposited before the main compressive forces acted which caused the first Black Hills uplift.



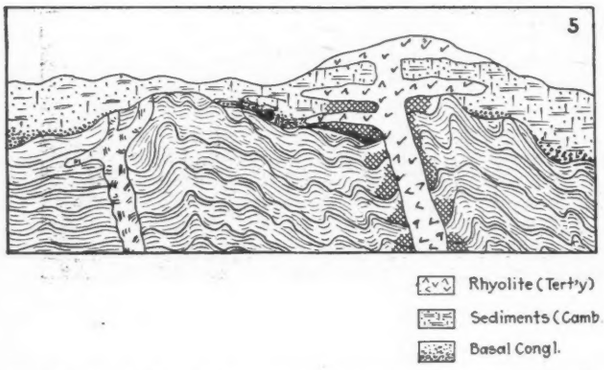
Illustrating the position of beds after the main uplift. The compressive force was so great that the folds were overturned and the softer beds were pinched to a fraction of their original thickness. The Laurentian revolution caused this uplift, followed by the Sudburian period of erosion and then the second uplift and intrusion (Algonkian).



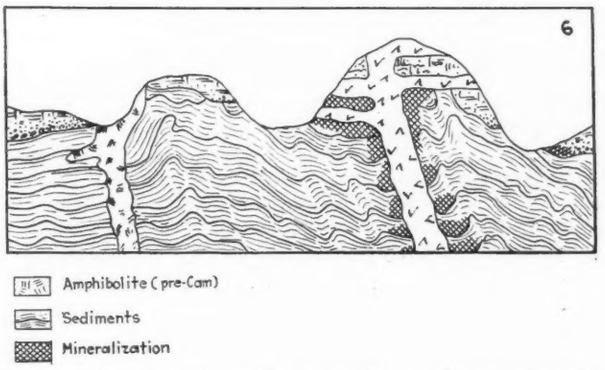
An intrusion of amphibolite occurred after the folding and before Cambrian time, placing the probable age of this intrusion as Keweenawan. Amphibolites occur east of Lead. The effects of the Algomian intrusion of granite (Harney Park and Southern Hills district) are not shown, as they do not occur in the northern hills.



During Cambrian time erosion and submergence took place. The Cambrian formation remains as evidence. It is doubtful if the later sediments were deposited upon the Cambrian at elevations equal to that of Lead until the deposition of the White River formation of Tertiary age (Oligocene).



Illustrating the intrusion and extrusion of rhyolitic rocks of Tertiary (Eocene) age, and the partly eroded Cambrian sediments; also the mineralization in the dolomitic rocks.



Since the eruption of the rhyolitic rocks erosion has taken place, leaving the present surface relations. This does not take into account the White River formation. Mineralization of the replaceable beds is shown.

Important stages in the formation of the Homestake deposit

There is only one phonolite porphyry dike in the mine. It outcrops on the surface near the assay office, striking N. 45 deg. E. and dipping 31 deg. to the northwest. Its average width is 35 ft. The dip is such that the dike leaves the mine workings on the north end of the 1,250 level. The contacts are uneven but sharp, suggesting that it was intruded along a large, smooth fracture plane. No breccias have been observed. This dike cuts the rhyolite dikes, and therefore is the younger. Exposures of the phonolite porphyry weather rapidly in the mine and become earthy, making timbering necessary where it is intersected by a drift.

A fracture system parallel to the strike of the dike is conspicuous in the south end of the upper mine workings. It is a question whether the dike caused this system of fractures or whether the fractures are related to the one which determined the position of the dike.

General Geological Features (Historical)

Inasmuch as the geology of the Lead district is quite complex, it is well to devote a part of this report to an outline of the historical side of the subject, in order to clarify following references to structure and rock types.

A series of sketches has been prepared in an effort to aid in the description of the processes through which the rocks of the district have passed, giving rise to their present stratigraphic and mineralogic relations.

Sketch No. 1 of this series illustrates the position of the sediments, which make up a greater part of the rock now exposed, during pre-Cambrian times and just before the compressive forces acted which caused the Black Hills uplift (first). We believe that this series of rocks are of Keewatin age, the opinion being the result of observations which have taken into account the lithology and the presence of intrusives of post-folding time comparable to those of Keweenawan age in other districts. The tightly folded and crushed complex of this series is evidence enough that the forces responsible were compressive, at least in so far as the area involved is concerned. This condition is illustrated in sketch No. 2.

The dike shown in No. 3 is representative of a series of dikes of a basic, well-crystallized intrusive which is essentially an amphibolite. It was with some difficulty that the age of this series was settled upon, as the dikes are irregular, fragmental, and with uncertain relations. The fact that these dikes cut the sedimentary beds could not be accepted alone as evidence of post-folding intrusion. But they not only cut the sedimentary beds—they cut the folds as well. From their occurrence with reference to later rocks they cannot be assumed to be of later than Keweenawan age. There is no evidence to indicate that this series of dikes is in any way responsible for the mineralization or any part of it.

After the intrusion of the amphibolites and before the deposition of the Cambrian sediments (flat formation) occurred a great interval of erosion, probably the third or epi-Proterozoic, during which a large portion of the Keewatin sediments and those of later age (Algonkian) were carried away to lower elevations, thus cutting deeply into the folded series and creating a new land surface upon which the Cambrian sediments were deposited, either by submergence of the general land sediments or inundation by the rising seas. The completed deposition of this series of rocks is illustrated in sketch No. 4. They rest unconformably upon the Keewatin schists and slates ("vertical formation"), with an intervening bed of relatively thin conglomerate. It was in this bed of conglomerate that the early "cement workings" produced considerable gold. The dolomitic limestone of the lower Cambrian also proved receptive to later mineralizing solutions. This phase will subsequently be discussed more fully.

From the end of Cambrian time to the introduction of rhyolite and rhyolite porphyries of the early Tertiary (Eocene), the sediments that surround the Black Hills dome were being deposited during the several periods of geologic time which intervened. It is problematical just what thickness of these later sediments covered the hills. However, the pre-Cambrian surface was again bared, with an occasional area left with a capping of Cambrian sediments.

Sketch No. 5 illustrates the eroded Cambrian surface and the intrusion and extrusion of Tertiary (Eocene) porphyries, which for the most part are siliceous. These are to be found in connection with all of the mineral deposits in and around Lead, whether in the vertical schists or flat-lying Cambrian and later sediments. They occur as dikes and sills; as dikes in the vertical schists and mostly as sills that have been formed by the spreading of the magma upon encountering the less resistant flat-lying sediments. Their bearing on mineralization will be discussed more fully under "Age of the Gold."

Sketch No. 6 is intended to illustrate the relations as they now exist, with considerable erosion having taken place since the Tertiary disturbances, which no doubt caused considerable additional uplift in the northern hills, although less important than those periods of uplift previously mentioned.

Following soon after the intrusion and extrusion of the Eocene volcanics came the deposition of the White River sediments of Oligocene age, covering the hills and outlying plains. This formation in turn has been eroded until only relatively insignificant patches are left here and there. Small areas are to be found in South and West Lead, composed of clay, clay shale, fragments of pre-Cambrian schists, Cambrian conglomerate, quartzite, and Eocene porphyries.

An intrusion of phonolite porphyry occurred probably in late Eocene time, as a dike of it is found in the Homestake mine cutting the rhyolite dikes. Fragments of this intrusive are also to be found in the White River formation. The dike of phonolite porphyry which occurs in the Homestake mine cuts the orebodies also, but it is quite certain that it had no bearing on mineralization. Surface outcrops (extrusive) are to be found southeast of Lead on the hill known locally as Table Rock; also on the ridge south of town, overlooking Whitewood Creek and Kirk.

To be concluded

Ceylon Graphite Industry Improves

The graphite industry of Ceylon has not recovered from the slump that occurred at the close of the Great War. The larger mining centers have been shut down for the last four years, and only a few of the smaller mines have been active.

However, according to *Commerce Reports*, exports in 1922 showed a great increase over those during 1921, and were larger in volume than in any year since 1918; they were still, however, much below pre-war exports and were less than one-third the shipments of the peak year of 1916. The prices obtained last year were not so high as those of 1921, although they exhibited a hardening tendency in the final quarter.

The Director of Mines of the Government of Ceylon states in a recent report that on May 1, 1922, a little over 20,000 tons of all grades of graphite were being held in the island. This stock was reduced by Jan. 1, 1923, to 15,100 tons.

The United States has been by far the largest purchaser of Ceylon graphite during the last ten years and took 134,893 hundredweight, or 64 per cent of the total exports, in 1922. This is a 213 per cent increase over the amount bought by America in 1921. Other large purchasers in 1922 were the United Kingdom, Japan, Germany, Australia, India, Burma, and France.

No shipments were made to Belgium during the war years, but exports to that country and to France and The Netherlands as well are now on the increase.

An increased demand for graphite was felt during the last three months of 1922. As a result, the opening of additional mines is likely, but until present stocks are still further reduced a general resumption of mining will not occur. It is doubtful if many of the larger pits will reopen before the middle of 1924 unless a heavy demand for Ceylon graphite develops.

The Marketing of Bauxite

Principal Source of Aluminum—Also Used in Chemical Manufacture and Production of Refractory Brick—Occurs Chiefly in Southeastern Part of the United States

By J. M. Hill*
Geologist, U. S. Geological Survey

Bauxite is the ore of aluminum. the crude material for the manufacture of artificial aluminum abrasives, such as alundum, the chief crude material for the manufacture of various aluminum salts, such as alum, aluminum chloride, and aluminum sulphate, and is used to some extent in the manufacture of aluminum refractories, which are sold as bauxite brick or high-alumina brick.

For the aluminum industry bauxite must be first treated in a chemical plant for the preparation of practically pure alumina, and for the manufacture of aluminum chemicals the bauxite is first chemically treated. For the manufacture of abrasives and refractories the material is used without preliminary treatment other than drying and fine grinding for mixing with other ceramic material for refractory purposes.

Since most bauxite, as mined, contains considerable water, the usual practice is to dry it before shipment, thus cutting freight cost. A small quantity of domestic bauxite is shipped without drying, and some is calcined at high temperature before shipment. The great bulk of domestic bauxite is shipped dried.

As will be seen from Table I, compiled from the annual reports of the U. S. Geological Survey, Arkansas has always produced the great bulk of bauxite mined in the United States. Deposits which normally yield 10 per cent of the United States supply are situated in northeast Alabama, northwest and central Georgia, and southeast Tennessee, in what may be termed the eastern field.

As will be seen from an inspection of Table II, France has been the second largest bauxite-producing country in the world, though it is quite probable that in the near future British Guiana and Dalmatia may supply more than France. The African and Indian deposits are known to be extensive, and at some future period they will undoubtedly be the chief sources of supply of the mineral.

The United States is the largest consumer of bauxite in the world; France ranks second, Germany third, England fourth, and there is a small consumption in Italy. The chief consumer is the aluminum industry, second is the aluminum salts industry, and third is the aluminum abrasives. A small quantity is consumed in the manufacture of refractories. As a measure of the consumption by industries, Table III, showing the consumption in the United States by industries, may be instructive.

In the United States the chief consuming centers are East St. Louis and Joliet and vicinity, in Illinois; Cincinnati and Columbus, in Ohio; Pittsburgh and Philadelphia, in Pennsylvania; Niagara Falls and New

I—Production and Consumption of Bauxite in the United States, 1912-1922

In Long Tons

Year	Domestic Production: Georgia, Alabama, and Tennessee Quantity (Long Tons)	Georgia, Alabama, and Tennessee Value	Arkansas Quantity (Long Tons)	Arkansas Value	Total Quantity (Long Tons)	Total Value	Imports Quantity (Long Tons)	Imports Value	Exports (a) Quantity (Long Tons)	Exports (a) Value	Domestic Consumption Quantity (Long Tons)	Domestic Consumption Value
1913	40,370	$150,710	169,871	$846,988	210,241	$997,698	21,456	85,746	(b)	(b)	231,697	$1,083,444
1914	24,071	92,508	195,247	976,686	219,318	1,069,194	24,844	96,500	(c)5,374	$240,084	238,788	925,610
1915	28,245	144,345	268,796	1,370,489	297,041	1,514,834	3,420	17,107	16,082	717,186	284,379	814,755
1916	49,190	284,810	375,910	2,011,590	425,100	2,296,400	30	87	18,032	987,454	407,098	1,309,033
1917	62,134	395,051	506,556	2,724,007	568,690	3,119,058	7,691	28,989	21,791	1,323,926	554,590	1,824,121
1918	42,829	314,112	562,892	3,133,880	605,721	3,447,992	3,653	14,791	19,711	1,523,688	589,663	1,939,095
1919	43,076	346,588	333,490	1,855,159	376,566	2,201,747	6,082	36,820	17,701	1,372,094	364,947	866,473
1920	40,029	349,453	481,279	2,897,892	521,308	3,247,345	42,895	251,284	22,257	1,843,596	541,946	1,655,033
1921	14,700	134,400	124,850	755,400	139,550	889,800	27,587	164,589	5,942	488,785	161,195	565,604
1922	42,800	329,400	266,790	1,602,890	309,590	1,932,290	18,427	72,534	19,617	961,208	271,546	1,043,516

(a) Includes bauxite concentrates.
(b) Included in "All other articles."
(c) From July 1, 1914.
(d) From Jan. 1 to Sept. 21, 1922, inclusive; no figures for imports since new tariff act went into effect.

II—World's Production of Bauxite, 1913 and 1916-1921, by Countries

In Metric Tons

Country	1913	1916	1917	1918	1919	1920	1921
Austria							
Dalmatia	(a)	83,837	(b) 134,781	94,500	(a)	(c)	(c)
Istria	(a)	58,489	28,341	(b) 70,100	(a)	(d)	(d)
Lower Austria (e)						362	2,638
British Guiana			2,070	4,266	1,999	31,883	12,584
British India	1,203	762	1,385	1,211	1,709	3,995	4,728
France	309,294	(b) 106,170	(b) 120,883	(a)	159,103	266,700	(b) 84,942
Germany	(f)	(f)	10,813	14,353	9,393	13,420	(a)
Hungary	1,792	(a)	(b) 128,651	(a)	(a)	(a)	(a)
Italy	6,952	8,887	7,789	7,800	2,972	(d) 13,139	(d) 49,100
Spain				460	1,780	540	184
United Kingdom	6,152	10,495	14,960	9,743	9,369	11,197	2,305
United States	213,615	431,923	577,817	615,443	382,610	529,675	141,790
Jugo-Slavia: Dalmatia	(g)	(g)	(g)	(g)	(g)	27,860	(b)(h)51,000

(a) Data not available. (b) Unofficial figures. (c) Now included under Jugo-Slavia. (d) Istria included under Italy. (e) No record of any production prior to 1920, when one mine was operated. (f) Prior to 1917 no separate figures of bauxite production available. (g) See Austria. (h) Exports.

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III—Domestic Bauxite Consumed by Various Industries, 1917-1922

In Long Tons

Year	Industry			
	Aluminum	Chemical	Abrasive	Refractory
1916	300,000	80,000	45,000	
1917	375,000	82,000	110,000	2,400
1918	419,000	63,900	112,900	9,900
1919	272,300	67,800	35,400	1,100
1920	383,200	85,900	52,300	
1921	91,700	41,000	6,900	.....
1922	211,550	70,000	19,300	300

York City and vicinity, in New York; and Boston and vicinity, in Massachusetts. (See Map).

The following list comprises the known domestic consumers of bauxite during recent years:

Aluminum Company of America, Pittsburgh, Pa.
Carborundum Co., Niagara Falls, N. Y.
Charles Lennig & Co., Inc., 112 South Front St., Philadelphia, Pa.
Charles Taylor Sons Co., Cincinnati, Ohio.
Columbus Waterworks, R. D. 5, Columbus, Ohio.
Columbus Waterworks, Columbus, Ga.
Como Chemical Co., Kokomo, Ind.
Detroit Chemical Works, 238 Junction Ave., Detroit, Mich.
E. I. du Pont de Nemours & Co., Wilmington, Del.
Evits Creek Water Co., Cumberland, Md.
Exolon Co., 156 Sixth Ave., Cambridge, Mass.
General Abrasives Co., Niagara Falls, N. Y.
(*a*) General Chemical Co., 25 Broad St., New York, N. Y.
General Refractories Co., Trinity Bldg., New York, N. Y.
Gulf Refining Co., Pittsburgh, Pa.
Harbison-Walker Refractories Co., Pittsburgh, Pa.
Herman Chemical Corp., Matteson, Ill.
Hudson Chemical Co., Albany, N. Y.
International Abrasive Corporation, 5 Dorchester Ave., Extended, Boston, Mass.
Jarecki Chemical Co., St. Bernard Station, Cincinnati, Ohio.
(*b*) Kalbfleisch Corporation, Chattanooga, Tenn.
Kansas City Water Department, Kansas City, Mo.
Laclede-Christy Clay Products Co., St. Louis, Mo.
Massillon Stone & Fire Brick Co., Massillon, Ohio.
(*c*) Merrimac Chemical Co., 33 Broad St., Boston, Mass.
Metropolitan Water District of Omaha, Omaha, Neb.
Montclair Water Co., Paterson, N. J.
Montreal Waterworks, Montreal, Quebec.
Norton Co., Worcester, Mass. (also Niagara Falls, N. Y.).
(*d*) Pennsylvania Salt Mfg. Co., Widener Bldg., Philadelphia, Pa.
Springfield Waterworks, Springfield, Mass.
Superior Chemical Co., Joliet, Ill.
Trenton Filtration Plant, Westfield, N. J.
Welch Chemical Co., 8 East Long St., Columbus, Ohio.

(*a*) Operating plants at Bay Point, Calif.; Claymont, Del.; Chicago Heights and East St. Louis, Ill.; Laurel Hill, N. J., and Cleveland, Ohio.
(*b*) Operating plants at Erie, Pa., and Chattanooga, Tenn.
(*c*) Operating plants at Everett and Woburn, Mass.
(*d*) Operating plants at Natrona and Philadelphia, Pa.

Grades of Bauxite

The following table, IV, gives analyses of typical foreign and domestic bauxites. Arkansas bauxite is considered the best domestic material, and is practically the only bauxite used in the aluminum industry. Georgia bauxite finds its principal market with the chemical industry. The abrasive industry draws from both the Arkansas and Eastern fields, the material suited for this industry being sorted in mining.

IV—Analyses of Bauxite

Location	SiO_2	Al_2O_3	Fe_2O_3	TiO_2	Water at 100°	Authority
Alabama	7	56–60	2.75	2–3	25–30	McCalley: Ala. Sci. Soc.
Arkansas	10.64	57.48	2.56	1.20	28.36	Mead: Ecom. Geol., Vol. 10, p. 48.
Georgia	14.47	54.57	1.93	1 63	26.93	Sherer: Ga. Geol. Sur. Bull. 31, p. 79.
	8.84	58.38	1.30	1.80	29.25	Sherer: Ga. Geol. Sur. Bull. 31, p. 70.
	10.63	57.91	0.96	1.44	28.70	Sherer: Ga. Geol. Sur. Bull. 31, p. 37.
Tennessee	18.38	49.90	4.13	.....	27.59	Phalen: U. S. Geol. Surv. Min. Res., 1912, p. 5
	17.16	53.34	2.10	Omitted	Omitted	Unpublished data.
French bauxite	2.8	57.60	25.30	3.1	10.80	Phalen: U. S. Geol. Surv. Min. Res., 1910, p. 8.

For the preparation of alumina low enough in silica to make aluminum, it was formerly believed necessary to have bauxite carrying over 52 per cent alumina (Al_2O_3) and less than 3 per cent silica (SiO_2). Now, however, it is understood that bauxite carrying less than 50 per cent Al_2O_3 and from 3 to 7 per cent silica

Map showing principal districts producing bauxite

is being used successfully in the United States. It is known that during the war German aluminum makers were using much lower-grade bauxites than was considered possible before, but, of course, cost of refining was not considered at that time. Practically all the domestic bauxite used for the aluminum industry comes from the Arkansas field and typical analyses are given in Table IV. It is known that the domestic aluminum industry is using bauxite having compositions ranging about as follows:

	High	Low	Average	Limit, Per Cent
Al_2O_3	61	57	..	None
SiO_2	9	3	5	6
TiO_2	4	2	3	4
Fe_2O_3	10	1	4	10
H_2O	27	22	25	None

The principal requirement for bauxite used in the manufacture of aluminum chemicals is that the alumina must go readily into solution in weak sulphuric-acid solution. It is preferred that the alumina content should be high, for the recoveries are better. Iron and titanium should be low, about 2½ to 3 per cent of each as a maximum. Silica can be high, and bauxites carrying as much as 19 per cent SiO_2 are successfully used, as the silica acts as a diluent. High-silica bauxites are not sought for the chemical industry, for recoveries are lower and acid consumption is higher as the silica content increases. Recently high-alumina clays that are not bauxites have been used for the manufacture of aluminum chemicals, and this use of certain grades of clays is likely to increase in the future.

For the abrasive industry, low-iron and titanium bauxites are preferred, though just why is not apparent, for in the electric-furnace treatment of bauxite to make abrasives it is entirely possible to care for considerable amounts of both elements, as they form cores consisting largely of ferrosilicon in the center of the fused mass

of alumina. The finer grades of aluminum abrasives are made from chemically prepared alumina. It is understood that the buyers for the abrasive industry usually require bauxites to carry less than 5 per cent silica, preferably 3 per cent; from 2½ to 4 per cent titanium oxide, and from 3 to 5 per cent ferric oxide.

High-Alumina Clays Used in Refractories Manufacture

Bauxite for refractory use should be low in iron and titanium, but may contain considerable silica. Within the last two years, so-called high-alumina clays carrying from 48 per cent to 52 per cent Al_2O_3, largely in the form of diaspore, have found a ready market in the refractory industry. Some high-alumina clays in which the excess alumina is probably in the monohydrate form, gibbsite, is also used in the refractory industry. The development of the use of high-alumina clays is believed to have just begun, as regards their utilization as a substitute for bauxite.

As most of the large consumers are also producers of bauxite, there is some uncertainty as to the conditions under which bauxite is marketed. The consumers know what they need for their own use, and so mine their deposits to fit their needs.

At the large mines the bauxite is crushed to one-half to one-inch mesh and put through rotary driers much like small cement furnaces, though the temperatures used are lower. At the discharge ends of the furnace, the material is sampled, usually by hand, and samples are sent to the chemical laboratory. Analyses of bauxite show alumina (Al_2O_3), silica (SiO_2), iron oxide (Fe_2O_3), and titanium oxide (TiO_2).

As the material has been dried before shipment, it is the usual practice not to allow it to get wet in transit, so it is shipped in box cars carrying from thirty to fifty tons each. I do not recall ever having heard of bauxite being shipped in sacks or barrels, and the usual practice is to ship in bulk. The small amount of bauxite shipped without preliminary drying could be loaded in gondolas. Because the value of crude bauxite is low, it does not appear to be necessary to insure shipments to primary consumers. Apparently most of the bauxite is sold under long-term contracts, and consumers' needs as to quantity and price are well understood by the producers.

Persons entering the bauxite-producing business should know clearly, by adequate sampling of their deposits, the character of their bauxite. The analysis should indicate fairly well what industry should be approached. Probably the best markets are to be found in the chemical industry, and there will be a growing demand for lower grades of bauxite for the manufacture of impure aluminum sulphate by the "Hoover" process at various municipal and industrial water-purification plants. During 1922 quoted prices ranged from $8 to $10 per long ton.

As stated before, the larger consumers are also producers of bauxite. Thus the Aluminum Company of America, the largest consumer in the United States, produces its own ores through its subsidiaries, the American Bauxite Co., operating in Arkansas; the Republic Mining & Manufacturing Co., operating in Arkansas, Alabama, and Georgia; the Demerara Bauxite Co., operating in British Guiana; and the Surinaamsche Bauxite Maatschappij, operating in Dutch Guiana. The Kalbfleisch Corporation operates its own properties in Georgia and Tennessee. E. I. du Pont de Nemours & Co. formerly operated bauxite mines in Georgia and Alabama, but have stopped mining. The Norton Co. owns deposits of bauxite in Arkansas, which are operated when conditions warrant. It is understood that another maker of abrasives and one of the aluminum chemical companies are both interested in certain bauxite-mining operations in Georgia.

The following is a list of bauxite producers in the United States in 1922:

American Bauxite Co., 1111 Harrison Bldg., Philadelphia, Pa.
Globe Bauxite Co., Joliet, Ill.
Hebble Estate, Carterville, Ga.
Ideal Bauxite Co., Ellaville, Ga.
Kalbfleisch Corporation, 300 Fifth Ave., New York City.
Norton Co., Worcester, Mass.
Republic Mining & Manufacturing Co., 1111 Harrison Bldg., Philadelphia, Pa.
Warner Mining Co., Adairsville, Ga.

Bauxite prices have been quoted only in the last year or so. As a matter of fact, practically all of the bauxite used in the United States is sold under long-term contracts, so the quoted prices apply to an insignificant part of the output of the mines.

The prices in the following table are the average sales prices as given in the annual reports of the U. S. Geological Survey. They are considerably under the price which would have to be paid for small lots of bauxite in the open market. It is believed that they represent mining, hauling, and preparing cost, plus a liberal profit to the mining companies. They do not include railroad freight to consuming plants. Bauxite is always handled in long tons of 2,200 lb., though refined bauxite (alumina) and all of the products made from bauxite are sold on the short-ton basis, with the exception of aluminum, which is sold by the pound.

V—Prices of Bauxite per Long Ton, f.o.b. Shipping Point, 1913-1922

Year	Average Price of Domestic Bauxite
1913	$4.75
1914	4.87
1915	5.10
1916	5.40
1917	5.48
1918	5.69
1919	5.85
1920	6.23
1921	6.38
1922	6.25

As will be seen by a study of Table I, imported bauxite is not an important factor in the domestic situation. Most of the imported bauxite is used by makers of chemicals, though some is used by the abrasive industry whose plants are situated on the Atlantic seaboard, so the sea-borne freight rate is the determining factor as to which plants shall use foreign bauxite.

It may be of interest to compare the value of products made from bauxite with the value of the crude material at the mines. It will be noted that information of the value of artificial aluminum abrasives and aluminum refractories is meager, but some measure of the value of these products may be had by studying the figures of consumption of bauxite by industries, as given in Table III.

VI—Value of Products Made From Bauxite, 1913-1922

Year	Value of Bauxite F.o.b. Mines	—Value of Materials Made from Bauxite— New Aluminum	Aluminum Chemicals	Aluminum Abrasives	Aluminum Refractories	Total Value
1913	$977,700	$9,450,000	$3,290,500	.....	.....	$13,718,200
1914	1,069,200	10,080,000	3,508,600	.....	.....	14,657,800
1915	1,514,800	16,280,000	3,923,800	.....	.....	21,718,600
1916	2,296,400	33,900,000	5,588,600	$2,139,230	$100,000	44,024,230
1917	3,119,100	45,882,000	6,763,500	6,970,000	.....	62,734,600
1918	3,448,000	41,159,000	7,524,500	.....	.....	52,131,500
1919	2,201,700	38,558,000	7,642,300	.....	.....	48,402,000
1920	3,247,300	41,375,000	9,221,000	.....	.....	53,843,300
1921	889,800	10,906,000	6,872,700	.....	.....	18,668,500
1922	1,935,800	13,622,000	8,813,000	.....	.....	24,370,800

A Graphical System of Picturing Mining Methods

By the Use of Colored Crayons and Paper Cut-outs the Successive Stages in a Mining Operation Are Vividly Indicated—Principle Admits of General Application

By Clarence M. Haight
Mine Superintendent, New Jersey Zinc Co., Franklin, N. J.

SOME TIME AGO I was requested to give a talk on the mining methods used at the Franklin mine of the New Jersey Zinc Co. to the foremen and shift bosses at the smelting plant to which the ore was sent. As the plants are situated in different states, there was little opportunity for the exchange of visits. For several reasons this talk was postponed. In the meantime it was suggested that the subject might be of interest to those studying mining, so it was recently presented before a mining class at one of the universities. The method used to show each step graphically was considered worth a request that it be described in this publication.

The method was developed with the idea of presenting underground conditions and operations to men who had never been underground and who had no idea, or at the most a hazy one, of how the ore they smelted was obtained. It was necessary, therefore, that each step be presented as vividly as possible in its relations to the preceding and following ones. The scheme as worked out can be expressed in a few words.

A cross-section of a part of the orebody was taken as a basis from which to start, and a composite section at right angles to that cross-section was also used. These sections were drawn to a large scale on detail paper; the permanent features, such as the footwall and hanging-wall lines and drifts, were inked in and the different rock formations were indicated by various colors, put on with ordinary blackboard crayons. The chalking was done heavily enough to show the colors distinctly, but lightly enough to allow for erasing with art gum when excavations were to be indicated. (A change has been made since the first presentation of this method, in that a flexible blackboard has been substituted for the detail paper and the permanent features put on with paint instead of ink. This arrangement allows much heavier and more distinctive chalking to be done and permits easy erasing.) See Fig. 1.

Representations to scale of various construction features, such as a line of timber sets, tram cars, props, cribbings, and other types of timbering, were made on detail paper, colored, and, when necessary, cut out to allow the things behind them to be seen. See Fig. 2. As the description of the work progresses, these representations are placed on the sections (already pinned to a board) and held in place with pins or thumb tacks, to indicate the construction in the mine. These can be removed again to indicate the destruction or salvage of those structures. At the same time the chalked colors can be erased to indicate the removal of rock or ore and other colors put on to show the extent of the filling material when that is placed. That is the gist of the method.

The accompanying illustrations are photographs of different stages in the explanation of a method of overhand stoping on drift sets, with waste fill to replace the ore extracted. One end of the stope is the hanging wall and the other end is the footwall; the sides are solid ore left as pillars between the stopes. The length is determined by the distance between the footwall and hanging wall, but the width is kept constant at about 18 ft. The stopes are started at the bottom of the orebody or at some level decided upon and progress upward from level to level in cycles of breaking, drawing, and filling until the top of the orebody or some other limit is reached.

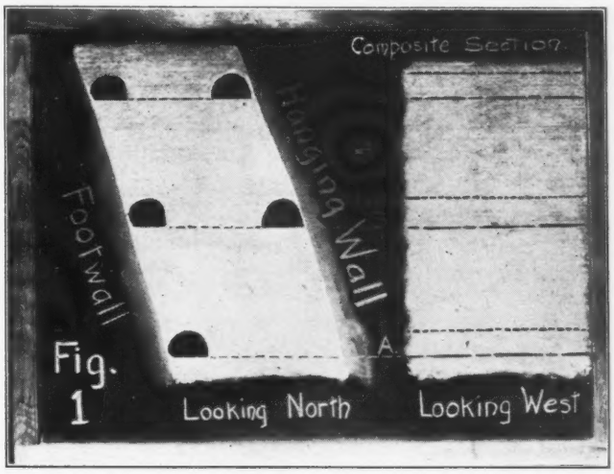


Fig. 1

Fig. 1 shows the blackboard with the sections as originally drawn. The composite section will have to show the operations from the hanging wall to the footwall; hence the term.

Fig. 2 shows some of the cut-outs used to represent structures built or used in the mine.

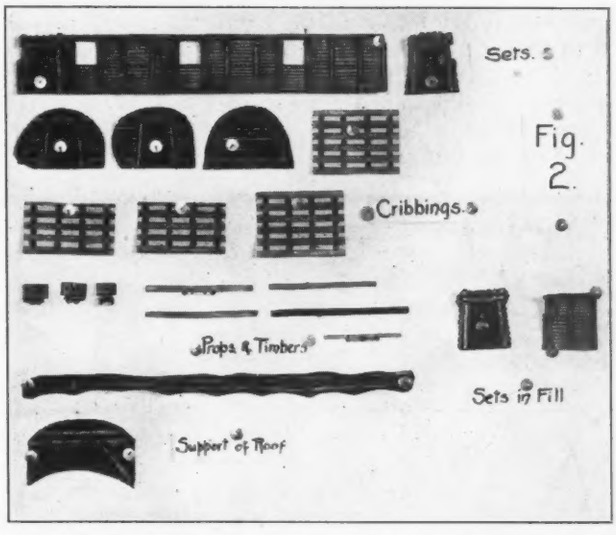


Fig. 2.

Fig. 3 illustrates the arrangement after several development steps have been taken; first the crosscut driven on level A from the footwall drift to the hanging wall; then the stripping of this crosscut to a width of 18 ft., and to a height of about 15 ft., and the erection of the

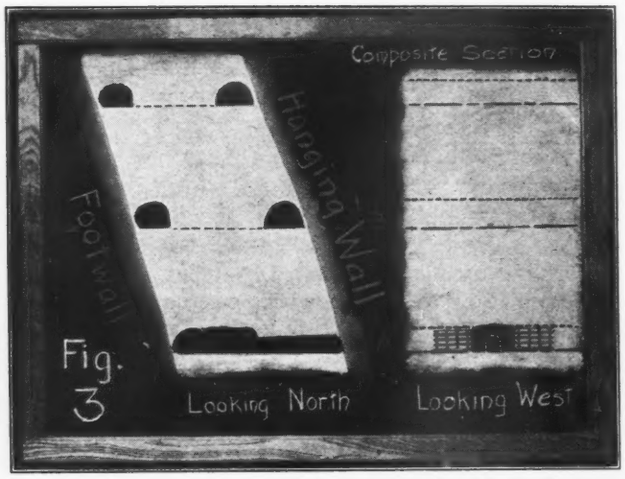


Fig. 3

cribbings in the drift on the footwall, one on each side of the stope.

Fig. 4 shows several steps additional, after the crosscut is stripped and the sets are placed in the center. These sets have chutes in every other space, alternating on each side of the center. Fill was placed behind

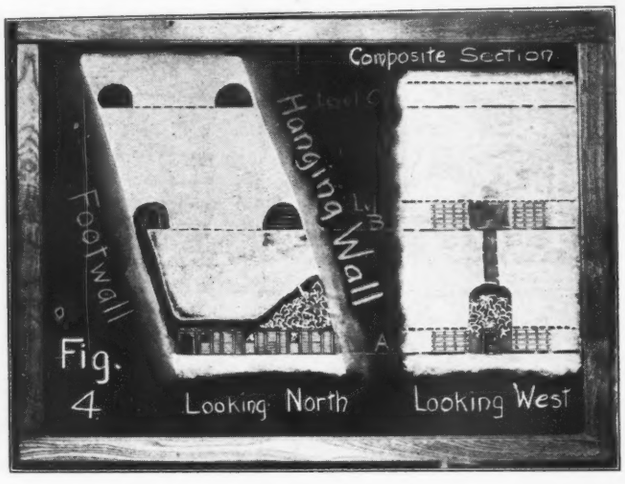


Fig. 4

these sets to the height of the chutes; a raise was put up to the level above, on the footwall, and mining was started on the hanging-wall end. The drifts on level B have been filled with cribbings on each side of the stope. A prop indicates how a bad piece of the back is supported on the broken ore.

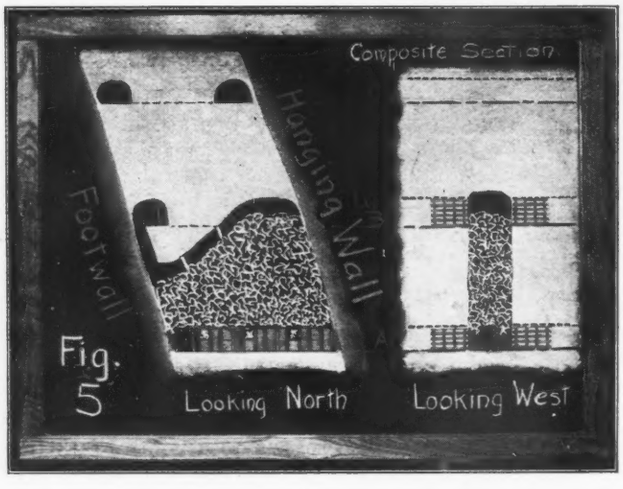


Fig. 5

Fig. 5 shows the hanging-wall end of the stope carried to the ultimate height of that lift, and also the clearance kept between the broken ore and the back of the stope for working room. The necessity for the raise on the footwall for access is now seen.

To reach the stage shown by Fig. 6, the breaking operations had to be completed, a raise driven to the level above, on the footwall; the top of the stope caught up with timber (for safety), the levelers for a future track placed on grade (drawn with chalk in one section), the broken ore pulled down beginning at the hanging-wall end, and props placed in the stope to support any bad pieces on the sides.

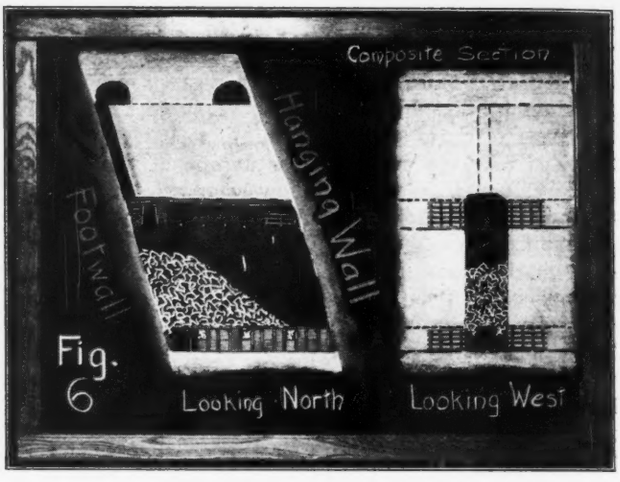


Fig. 6

Fig. 7 represents the stope after it has been emptied, after the sets have been removed, and the passageway sets placed in the footwall drift, and fill dumped down the raise from level C. This fill was leveled off so that

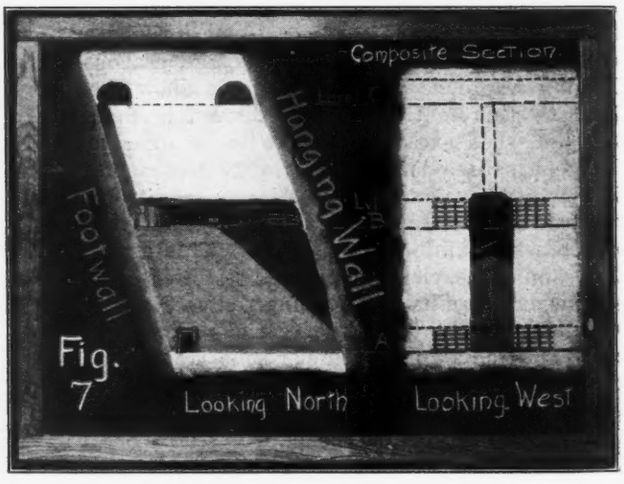


Fig. 7

the chute could be built under the raise and the remainder of the fill placed with a tram car. After filling the stope completely, erecting sets on that fill and removing the back timbers, the stope is ready to be carried up another lift. This is shown by Fig. 8.

This same type of explanation has been applied to top-slicing methods with equal success, and undoubtedly can be used to explain other methods. Perhaps a plan, in addition to the sections, might be an added advantage in some cases.

When making an explanation of this sort the amount of detail used may be suited to the audience, but unless that audience is well acquainted with mining methods,

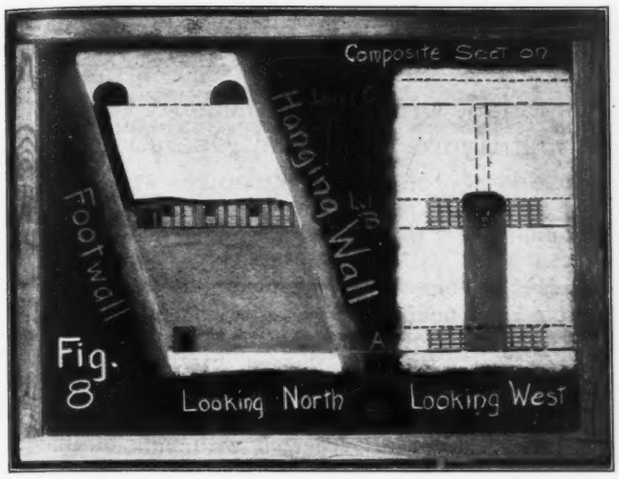


Fig. 8

considerable detail does not become tiresome; in fact, to several visitors of extensive mining experience the use of these diagrams was a decided help to their understanding of the method, even though they had just completed a trip underground.

It has been my experience that many of those who describe mining methods in print assume that their readers are as familiar as they with methods, terms, and appliances. I believe the contrary to be true in the majority of cases, and many times the poor readers are left puzzled and "peeved" because of the lack of an additional sketch or so, or the explanation of a detail that is not understood.

Placer Operations Near Cariboo, B. C.

By Donald D. Fraser

THE expectations of a mining boom in the Cariboo district of British Columbia during 1922 were not fully realized. It had the experience, however, of an awakening interest from outside. The prospector and the promoter have been increasingly in evidence and at least one "capitalist" has been looking over the ground. The Pacific Great Eastern Ry. now runs into Quesnel on a weekly schedule. For the first time in its history, Cariboo is accessible. The railroad has ousted the freight wagon as the freight wagon ousted its predecessor, the pack train. The cost of freight on machinery from Vancouver to Quesnel has been cut from 5c. to about 1c. a pound.

The year 1922 was a poor one for the hydraulic mines. The previous winter brought little snow and was followed by an exceedingly dry summer, so the gold production from that source was disappointing. Several of the mines were not able to realize on their season's work, for lack of water to clean up their pits.

The strike at Cedar Creek caused a small stampede, which was evidently fostered, if not engineered, by interested parties. Many people went in from Vancouver and other neighboring points. As in such rushes, many were entirely unprepared for conditions as they existed. The excitement died down after a few months.

Most of the ground is too wet to be prospected by shafts, and so still remains unproven.

Water in quantity for hydraulicking is lacking. So far the "pay" has been extracted by rockers, and, as ground to the value of $500 a cubic yard has been found, it has paid well. The production for 1922 was approximately $70,000. The nature of the deposit seems to be still a question. At first it was supposed to be a high run of the Quesnel River. It has since been claimed that it is a residual deposit from the weathering of a large low-grade basic dike which runs through the neighborhood.

The Kitchner mine, at Keithley, is said to have had a successful year. John Hopp ran his Lowhee and Mosquito Creek plants as usual. His Stouts Gulch property is evidently worked out, for it is claimed that the water will be transferred to Conklin's Gulch. This gulch was worked in the early days and paid extremely well as drifting claims. To work it as an hydraulic it will be necessary to move the town of Barkerville to make dump room. Hopp has been securing options on the Barkerville real estate. The Perkin's Gulch Mining Co. had the misfortune to have a serious wash-out on its ditch at the beginning of high water, which closed down the main plant for the season. The company did, however, operate its small plants with fair success. The Bullion mine is still inactive.

The Tertiary Mining Co., of Chicago, spent four months testing its ground by drifting. Its deposit is unique in this district. It consists of an old channel which is crosscut by the present Fraser River at a point about twenty miles by river north of Quesnel. The deposit is now slightly cemented, although powder disintegrates it and makes washing possible. With the use of blast holes, the deposit should make an extremely attractive hydraulic mine, if run on a large scale. Almost unlimited water is available by ditching.

The Construction Mining Co., which has been prospecting Peter's Creek, has shut down for the time being. J. McDougal, in his shaft on Jack-of-Clubs Creek, has encountered ground running as much as 7 oz. to the 10-ft. set. L. Muller is drifting equally good ground on Dragon Creek.

Several drills have been working in the district during the past season. The one which has located the best ground so far has been operating on the Swift River near its confluence with Lightning Creek. Here Detroit interests claim to have proved sufficient ground to warrant dredging operations on a commercial basis. They said when leaving the district in the fall that they hoped to start construction of their dredge in the spring. It is reported that English capital will put a dredge on Cariboo Lake to dredge the deltas of Duck, Harvey, and Keithley creeks. It is fully expected that the present season will see the start of Cariboo's first real gold dredge.

I can see little hope for a mining boom in the Cariboo, but I do look for healthy development during the next few years, which will doubtlessly lead to greatly increased production.

Italian Mercury Output Increases

As a result of the acquisition of the Istrian mines, situated in the territory annexed after the war, Italy has risen to a position of importance as a producer of mercury. In 1919 the production of metallic mercury was only 548 tons, or one-half the average that was maintained during the war. In 1920 the Istrian mines produced 526 tons, and the total rose to 1,401 tons. In 1921 there was a decline to 1,071 tons, but in 1922 production rose to 1,530 tons. The decline in 1921, according to *Commerce Reports*, was primarily due to labor troubles at the most important mine in Tuscany, which was shut down for about six months.

Regeneration of Cyanide Solutions

Presence of Cyanicides at New South Wales Plant Made Ordinary Method of Cyanidation Impracticable, but by Recovering Copper and Hydrocyanic Acid, Operations Yielded a Profit—Sulphuric Acid Added to Neutral Solution

BY HARLEY B. WRIGHT

MY ATTENTION was first directed to the possibilities of the regeneration of cyanide solutions in 1919, when considering the treatment of a gold-residue dump at the Mitchell's Creek Gold mine, Bodangora, New South Wales. The material contained, as cyanicides, copper, lead, and bismuth, in sufficient quantity to render the ordinary direct cyanide method entirely outside the range of economical treatment, owing to high cyanide consumption.

The copper present in the sand portion of the dump was 0.1 per cent, equal to 2.2 lb. per ton, whereas in the slime it amounted to 0.33 per cent, or 7.4 lb. per ton. Lead only amounted to traces in the sand and 0.5 per cent in the slime. Bismuth was present in both products but was not estimated quantitatively.

From preliminary work it was found that for every pound of copper present, soluble in ammonia water, 3.3 lb. of cyanide was destroyed, and later practice in bulk treatment confirmed the earlier observations. Considerable experimental work was undertaken to evolve a method to reduce the amount of cyanide required to secure a satisfactory extraction of the gold. Owing to pressure of other duties, the behavior of the lead and bismuth was not studied to any extent, much as it was desired to do so. Preliminary leaching with sulphuric acid for the removal of the copper was found to be quite unsuitable, owing to the presence of calcium carbonate in considerable quantity. Sodium sulphide was tried as a preliminary wash to convert the copper into a sulphide, but this was as readily attacked by the cyanide solution as when present in the form of a carbonate. Ammonium salts, in conjunction with lime, were capable of dissolving a small portion of the copper present, but at a prohibitive cost. Ammonium salts, with cyanide and lime, gave satisfactory extractions, but as regards cost of treatment per ton, for chemicals, the result was in favor of cyanide alone. All the many methods of attack that were tried, either to remove the copper or render it inert, proved unavailing, and until regeneration was finally considered, the problem appeared to be quite hopeless.

In "Cyanide Practice," by Max von Bernewitz, some prominence is given to a review of cyanide regeneration, and the following reactions on the subject, as submitted by W. D. Williamson, were carefully considered:

(1) $Cu_2(CN)_2 2KCN + H_2SO_4 = Cu_2(CN)_2 + K_2SO_4 + 2HCN$

The copper cyanide precipitate was recovered by filtration and the solution charged with hydrocyanic acid was rendered alkaline by lime water:

(2) $K_2SO_4 + 2HCN + Ca(OH)_2 = CaSO_4 + 2KCN + 2H_2O$

To recover the cyanogen still held in combination with the copper cyanide precipitate, the use of hydrogen sulphide was first adopted:

(3) $Cu_2(CN)_2 + H_2S = Cu_2S + 2HCN$

Finally, the two operations (1) and (3) were combined by adding to the cupriferous cyanide solutions sufficient sodium sulphide to precipitate all the copper present after adding the requisite amount of sulphuric acid to complete the following reaction:

(4) $Cu_2(CN)_2 2KCN + Na_2S + 2H_2SO_4 = Cu_2S + 4HCN + Na_2SO_4 + K_2SO_4$

The cuprous sulphide was removed by filtration and the hydrocyanic acid recovered with milk of lime as shown in (2).

Theoretically, equation (4) appears to satisfy fully all the requirements for a complete recovery of the cyanogen entering into combination with the copper. Unfortunately, the reaction as indicated does not take place. Many experiments were carried out under varying conditions of acidity and neutrality. Partial precipitation of cuprous sulphide certainly occurred, but the main reaction appeared to be the formation of hydrogen sulphide, which did not act energetically enough to decompose the cuprous cyanide; sulphur dioxide was also given off and fine sulphur precipitated. However carefully the work was conducted, the regeneration of the cyanide was only in a few instances in excess of the amount recovered by the sulphuric acid method, and was not worth consideration. Even had sodium sulphide been as successful as the equation indicated, the successful filtration of the copper sulphide would have been extremely difficult, owing to its rapid oxidation. What, therefore, appeared a complete separation and recovery of the cyanogen from the cuprous cyanide solutions was reluctantly abandoned.

Metallic cyanides, when heated, are split up into the metal cyanogen and paracyanogen. Dry distillation in a retort yielded only 10 per cent of the theoretical amount, and distillation with sulphuric acid gave only slightly better results, on the air-dried copper cyanide. Electrolysis of the solutions containing the cupriferous cyanide was tried, but it did not yield results sufficiently attractive to warrant serious consideration. A review of innumerable tests finally led to the adoption of sulphuric acid for the regeneration. It is positive, easy of application, the precipitate is easily handled, and it gives a higher percentage recovery of cyanide than any other method. The practical application of the method, as finally evolved, is herewith described for the treatment of sand and shows the several steps found necessary to secure the most economical results:

Four pounds of lime per ton of sand, containing 80 per cent calcium oxide, were mixed with the sand going to the vats, to neutralize latent acidity; two tons of solution were applied for each ton of sand, and the treatment was extended over fourteen days. An essential condition for regeneration is to deprive the solutions of alkalinity or free cyanide, and for this purpose sump solution containing 0.06 per cent sodium cyanide and 0.04 CaO per cent calcium oxide was first run to the sand vats. For every ton of sand, half a ton of solution was used. The solution coming off was neutral to phenolphthalein, and was then pumped to the regenerating portion of the plant and handled as hereafter described.

The consumption of purchased cyanide was at the rate of 3.17 lb. of sodium cyanide per ton, besides the amount regenerated. It was found best, by repeated tests, to apply one case, or 224 lb., all at once to a vat containing 70 tons of sand. For this purpose, 20 tons of regenerated solution containing approximately 0.14 per cent free sodium cyanide and 0.10 per cent calcium oxide was run on to the cyanide placed on top of the sand. This gave a solution strength of 0.40 per cent, which was then circulated, at stated periods of eight hours, by an independent pump, for a forty-eight-hour contact. The solution was then allowed to drain to the zinc boxes, having a strength of 0.15 to 0.20 per cent free cyanide. No cyanide was added to the vats other than that regenerated from the prepared sump solutions, as explained later under Regeneration of Solutions.

It was found that the much-discussed selective affinity of dilute solutions for gold in preference to the base metals had no application. In every instance where the cyanide was applied in successive amounts of 40 or 60 lb. at a time, poor extractions took place. Regenerated solutions varying in strength from 0.18 to 0.12 per cent free cyanide followed to complete the extraction, and all moisture losses in discharged sand and by evaporation were made up by water washes.

Two methods were used to precipitate the gold: (1) The zinc box and (2) sulphuric acid. The zinc-box method was employed only for the richer and stronger cyanide solutions. Successful recoveries were impossible if the solutions were allowed to fall below 0 06 per cent free cyanide, and an alkalinity of 0.03 calcium oxide was maintained. The amount of zinc consumed amounted to 0.57 lb., costing 0.72/– (18c.) per ton of sand.

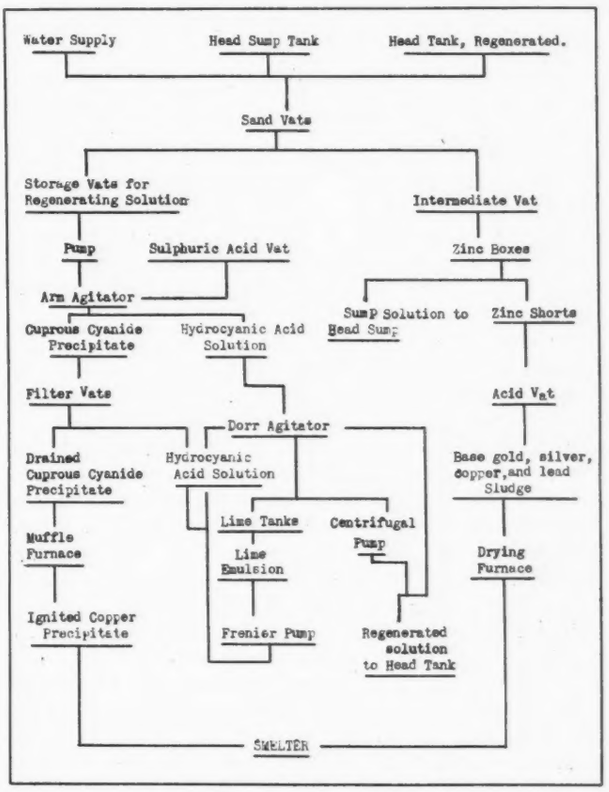
After a clean-up, the three head compartments were tightly filled with the remaining zinc, and the fourth with new. Every alternate day fresh zinc was added and shifted up when found necessary, and the boxes were cleaned out from end to end every two weeks. No fine sludge was ever formed, the zinc simply becoming short and rotten, with a tendency to cement loosely together. Some fine color displays were a feature of the operation; the three head compartments were black, and with every fresh addition of new zinc, metallic silver would shine out, to be soon followed by resplendent copper hues. Lime mud, mostly the sulphate, separated from the solutions in unusual amounts and carried 50 oz. gold, owing to contamination by minute particles of gold-zinc shorts.

The gold in the zinc-box heads ranged between 20/– and 6/– ($5 and $1.50) and the tailing after fresh zincing would be 0.8/– (20c.), gradually creeping up to 2s., 4s., 6s. and 8s. per ton; an 80 per cent precipitation of the gold represented good work and the most that could be expected under such conditions.

At previous periods in the mine's life, charcoal in small fragmentary form, placed in trays, and later applied as charcoal dust with a vacuum plant, was tried, found wanting, and abandoned. An electrical precipitation and regenerating outfit was also installed, but was subsequently thrown out in favor of zinc-box precipitation.

The short zinc removed from the boxes was treated with sulphuric acid, filtered, dried, bagged, and disposed of to the smelter with the incinerated product recovered from the regenerating plant. Local smelting of the gold sludge was found to be too costly, owing to its base nature. Refining of the sludge by boiling in concentrated sulphuric acid, later modified to Pearce's method, failed to produce a satisfactory product for subsequent smelting. A month's output was treated by the best refining and smelting methods, careful costs of all operations were recorded, and the verdict was much in favor of the smelter.

The solutions, free from any active cyanide or alkilinity, as already described, were run to separate storage sumps and later pumped to an elevated agitating vat of 50 tons' capacity. To this was added 80 per cent commercial sulphuric acid in sufficient quantity to



Flow sheet of treatment plant

throw down all of the copper present as cuprous cyanide. The amount of acid used varied from 700 to 380 lb. for every 50 tons charge of solution thus treated. The amount of acid for each charge was easily and rapidly ascertained by titrating 500 c.c. with the commercial acid until no further turbidity resulted, reading off the amount so used, and making the necessary calculation. It was not often that any adjustment was required, the end point being definite and easily determined after slight practice.

The agitating vat was then stopped and the cuprous cyanide precipitate was allowed to settle for one to one and one-half hours. The clear supernatant liquor, charged with hydrocyanic acid, was then decanted into a 50-ton Dorr tank at a lower level, the time taken being three-quarters of an hour. The smell of the hydrocyanic acid generated in the arm agitator was certainly unpleasant, but no ill or serious results ever resulted during the process of regeneration. The harshest complaint from the workmen was that it spoiled the flavor of tobacco, and the chewing plug lost its charm.

While the solution from the arm agitator was discharging to the Dorr tank, milk of lime was pumped in by a Frenier sand pump, which proved a most satisfactory device for the purpose. The lime emulsion was prepared by placing lime in three shallow, square iron tanks and allowing a small quantity of solution from the bottom of the Dorr to flow successively through them. It was found necessary to stir the lime vigorously during the operation, and from 700 to 1,000 lb. was used. Lime stirring ceased when the solution showed from 0.09 to 0.13 per cent free calcium oxide, and the average free sodium cyanide recorded amounted to 0.14 per cent. In addition to the stirring by the Dorr, and mixing by the Frenier, it was found advantageous to hasten the operation of making the solution alkaline by a further circulation of the solutions. For this a 4-in. centrifugal pump was used with the suction attached to the bottom of the Dorr and delivering over the side, back to the vat. The shallow lime-mixing tanks were cleaned of their insoluble residues after each operation, and the Dorr tank was cleaned of the accumulated lime sulphate and insoluble matter, at necessary periods of three to six months. The regenerated solution was then pumped to head tanks and used for mixing with fresh cyanide, or as washes following the strong solutions.

The cuprous cyanide precipitate was allowed to accumulate in the arm agitator until six separate operations had been carried through; then it was discharged, by sweeping through a 4-in. valve and pipe line, to three V-shaped wooden vats that had previously been used for charcoal-dust precipitation. Filters were put in across the V-section and also extended up the sides to the top of the vat, thus giving a five-sided filter. Coconut matting was placed over slats in the usual manner, and two layers of hessian (a coarse sacking made of hemp or jute) were used as a filtering medium. The filter vats were 7 ft. long, 3 ft. deep, and 3 ft. wide.

Six days were required to drain the precipitate before it was sufficiently dry to handle; it then retained 60 to 80 per cent moisture. It was grayish white in color and was known as "blanc-mange" by the plant epicures. Further removal of the moisture contents in a vacuum tub was not a success, but a pressure filter no doubt would have met the situation had it been found necessary.

The moist precipitate was at first placed in wrought-iron trays, dried, and ignited in a muffle furnace 12 ft. long, 3 ft. wide, and 2 ft. high. The trays were short-lived, owing to excessive corrosion, so the precipitate was fed directly on to the hearth of the furnace. When dried and heated it became self-consuming and was allowed to burn itself out to copper oxide, then cooled and stacked in tanks ready for bagging and sending to the smelter.

Precipitation of Gold by Sulphuric Acid

When cyanide solutions contain the double cyanide of copper, sulphuric acid affords an effective method for the recovery of the gold and silver. An 80 per cent precipitation of the precious metals was easily secured when throwing the copper out of solution after adding the sulphuric acid to the arm agitator. The precipitate, after ignition in the muffle furnace, assayed gold 70 oz., silver 140 oz., and copper 60 per cent, accounting for 25 per cent of the gold-silver output from the plant. Had it been possible to secure satisfactory extractions of the gold from the sand with weak cyanide solutions and to handle large volumes expeditiously this method would have been much preferred to the zinc box.

Quantity and Value of Cyanide Recovered by Regeneration

About 5,400 tons of solution was handled by the method described during the treatment of 10,261 tons of sand. The cost of operations is shown in statement No. 1. From this statement it is clearly shown

Statement No. 1

	Dr.	*Cr.*
Sulphuric acid: 47,952 lb. @ £18 per long ton	£385 4s. 0d.	
Lime: 47 tons @ 63 s. per ton	148 2	
Labor and power	75	
Cyanide recovered: 5,400 tons of 0.14 per cent sodium cyanide solution = 16,902 lb. @ 1.8 shillings per lb.		£1,521 3s. 0d.
Copper recovered at market valuation, 10,858 lb.		334 18s. 0.
To balance, being profit	£1,247 15	
	£1,856 1s. 0d.	£1,856 1s. 0d.

that for a total expenditure of £608 6s. 0d., 16,902 lb. of cyanide was recovered, having a value of £1,521 3s. 0d., and in addition 10,858 lb. of copper as a by-product, valued at £334 18s. 0d. During the treatment of the 10,261 tons of sand, purchased sodium cyanide to the extent of 32,541 lb. at 1.8s. per lb. was added, and from this was regenerated 16,902 lb., equal to 51.9 per cent, or a total consumption of 4.81 lb. per ton.

Statement No. 2—Treatment Costs on 10,261 Tons of Sand

	Total	Shillings per Ton
Wages	£2,200 8s. 4d.	4.30
Sodium cyanide	2,928 15 0	5.70
Zinc	368 2 3	0.72
Sulphuric acid	453 10 1	0.88
Lime	195 8 6	0.38
Power	262 19 3	0.51
Horse maintenance	246 19 3	0.48
Realization charges	671 7 6	1.31
General expenses	323 1 11	0.63
	£7,650 12s. 4d.	14.91
Revenue account		
Gold at £5 per oz	£7,961 0s. 0d.	15.51
Silver at market rates	420 6	0.82
Copper at market rates	334 18	0.65
	£8,716 4s. 0d.	16.98
Profit	£1,065 11s. 8d.	2.07

In considering the monetary values in Statement No. 1, cyanide having a value of £1,521 3s. 0d. was recovered, for an expenditure of £608 6s. 0d., showing a saving of £912 17s. 0d.

In Statement No. 2 the Revenue Account shows a return for copper sold of £334 18s. 0d. Had regeneration not been adopted, these favorable factors would not have operated, and Statement No. 3 discloses what the position would have been under direct cyanidation.

Statement No. 3

Treatment costs, as per Statement No. 2	£7,650 12s. 4d.
Extra cost for cyanide	912 17 0
	£8,563 9s. 4d.
Revenue account, as per Statement No. 2	£8,716 4s. 0d.
Less copper sold	334 18 0
	£8,381 6s. 0d.
Loss	£182 3s. 4d.

In conclusion, it may be said of the regeneration of cyanide from cupriferous cyanide solutions, that it shows a considerable economy in working costs, is easy of application, and was the means of bringing an otherwise unprofitable dump within the scope of treatment. The practical details and flow sheet given will permit of its ready adoption where similar conditions exist elsewhere.

Technical Papers

Silver—The report on silver recently issued by the Imperial Mineral Resources Bureau is an important contribution to a knowledge of the world's deposits and to an understanding of the industry. Full data on production and price are given, a detailed summary of recent operations at all of the world's silver mines, a good technical bibliography, and much other information of interest, such as a table giving the pre-war and present coinage standards of all countries. Australia and British Honduras now have the purest silver coins—925 fine. British East Africa stands at the opposite end with a fineness of only 250. The bulletin, which is of 218 pages, is obtainable for 4s. 3½d. from H. M. Stationery Office, Imperial House, Kingsway, London, W. C. 2, England.

Mineral Resources—Recent publications in the "Minerals Resources" series include: "Gold, Silver, Copper, Lead, and Zinc in Colorado in 1921," pp. 32; and "Gold, Silver, Copper, Lead, and Zinc in New Mexico and Texas in 1921," pp. 11; obtainable on request from the U. S. Geological Survey, Washington, D. C.

Pennsylvania Iron Ores—"Brown Iron Ores in Pennsylvania" is the title of an eight-page mimeographed bulletin, No. 63, recently issued by the Bureau of Topographic and Geological Survey, Harrisburg, Pa. These ores were formerly important, but recently have not been able to compete with the Lake Superior product except for special purposes. A description of the deposits, with analyses and other relevant information, is given.

Manganese Deposits—The U. S. Geological Survey, Washington, D. C., has recently issued two bulletins on manganese ore deposits, No. 734, "Deposits of Manganese Ore in the Batesville District, Arkansas," pp. 273, and "Manganese Deposits of East Tennessee," Bulletin 737, pp. 154. Either may be obtained on request to the Survey. These bulletins go into considerable detail regarding the types of deposits and give full descriptions of the various individual prospects and mines. Bulletin No. 737 includes a list of all mines and prospects, giving the name of owner and operator, and No. 734 contains a chapter on the mining and dressing of the ores that should prove of interest to any one in other parts of the world having to do with manganese mining. Excellent maps are included in each book.

Mining in Indo-China—A report on the mining industry of French Indo-China, pp. 23, has recently been published by La Vie Technique, Industrielle, Agricole & Coloniale, 18 Rue Séguier, Paris (VI), France. The report is taken from a recent special number of "L'Industrie en Indochine."

Pennsylvania Lead-Zinc Ores—Bulletin 69 of the Bureau of Topographic and Geological Survey, Harrisburg, Pa., four pages, is entitled "Lead and Zinc Ores in Bucks County, Pennsylvania," and describes the New Galena mine and the operations of the Guerden Glen Lead Mining Co. Intending investors in the shares of new companies planning to work in this district would do well to digest the information given in this paper. Bulletin No. 68 discusses the "Lead and Zinc Ores in Lancaster County, Pennsylvania." No mines in this section are now active, but the bulletin gives a résumé of what is known concerning former workings. The same can be said of Bulletin No. 65, on lead and zinc ores in Blair County; Bulletin No. 67, on lead and zinc ores near Phoenixville, Chester County; and of Bulletin No. 70, on zinc ores at Friedensville, Lehigh County. All of these bulletins are by the former special consulting editor of the *Journal-Press*, B. L. Miller.

Electric Furnaces—*The Iron Age* for April 19 (New York; price 25c.) contains a two-page article on "Lining Acid Electric Furnaces." Materials and methods are discussed from the practical standpoint.

American Mining Congress — The Third Standardization Bulletin, issued by the American Mining Congress, Washington, D. C., pp. 387, has recently been issued; price $1. It contains reports of interest on the following subjects: drilling machines and drill steel; underground transportation; fire-fighting equipment; steam-shovel equipment; mine ventilation; mechanical loading underground; mine timbers; mine accounting; and methods of mine sampling.

Charcoal Precipitation of Gold—In the March issue of *The Mining Magazine*, (Salisbury House, London Wall, London, E.C.2, England; price 1s.) appears a nine-page article on "Precipitation of Gold from Cyanide Solutions by Means of Charcoal." This is largely a record of work carried on at the Yuanmi gold mine, in West Australia, with informative comment.

Jet—U. S. Bureau of Mines, *Reports of Investigations* No. 2,452, obtainable on request to the Bureau at Washington, D. C., is a four-page pamphlet on the subject of jet. This is a dense black lignite, taking a good polish and sometimes used for jewelry. Its analysis, history, distribution of deposits, production and demand are briefly touched on. Black onyx is now more in favor for mourning jewelry, for which jet was formerly principally used.

Wire Rope—Mining engineers concerned with hoisting will find U. S. Bureau of Standards Technologic Paper No. 229 of interest. Tests of wire rope ⅝, ¾, ⅞, 1, and 1¼ in. in diameter were made on sheaves of 10, 14, and 18 in. diameter, to determine the rope strength under static load, and the results are here tabulated and interpreted. The sixteen-page paper is obtainable on request from the Bureau.

Screen Sizing—Prof. Ernest A. Hersam is spending a year at the Massachusetts Institute of Technology to make a survey of milling, under the auspices of the A.I.M.E. and the U. S. Bureau of Mines. Among other things he has studied the matter of proper screen sizing and has prepared an outline of the subject in mimeographed form, "A Standard Sizing Test," which may be obtained by writing to the Bureau of Mines, Washington, D. C. In this résumé he describes current practice and suggests improvements and changes. All who are interested in the subject are urgently invited to secure a copy of the paper and offer constructive criticism so that the best practice may be formulated and offered as a standard.

Copper in Pennsylvania — "Copper Ores in Pennsylvania" is the subject of Bulletin No. 71, Bureau of Topographic and Geological Survey, Harrisburg, Pa., eight pages, obtainable on request. There are no deposits of copper minerals that are of any importance in the state.

British Lead Industry—In *Chemistry and Industry* for March 16 (Central House, 46 & 47, Finsbury Square, London, E. C. 2, England; price 1s. 9d.) is the first instalment of a continued article on "The Production of Lead in Britain." This first section is entirely historical.

Rail Transportation—Those interested in the operation of American railways will find much important statistical data in the 1922 annual bulletin of the American Railway Association, Car Service Division, Washington, D. C., just issued. Copies may be obtained on request to the Committee on Public Relations of the Eastern Railroads, 143 Liberty St., New York City.

Mining in South Australia—The Mining Review of the Department of Mines, Adelaide, South Australia, for the half-year ended June 30, 1922, is now available; also the Annual Report of the Director of Mines and Government Geologist for 1921. The latter contains large maps, in colors, of Australia and South Australia. Either may be obtained on request.

Idaho Mining—The 1922 Annual Report of the Mining Industry of Idaho is now available from Stewart Campbell, Inspector of Mines, Boise, Idaho. It is a 209-page book giving reports on all of the mines and most of the prospects of the state.

Aërial Ropeways — In *The Mining Magazine* for March (Salisbury House, London, Wall, London, E. C. 2; price 1s.) is a short general article on aërial ropeways, giving a résumé of present practice and costs.

Mine Fires—Technical Paper 314 of the U. S. Bureau of Mines, Washington, D. C., obtainable on request, is an illustrated bulletin of twenty pages on "Metal-Mine Fires." It tells how such fires may start and how the hazard of fire may be lessened, information that is valuable and widely applicable.

SOCIETIES, ADDRESSES, AND REPORTS

M. & M. S. Medal Presented to Peele

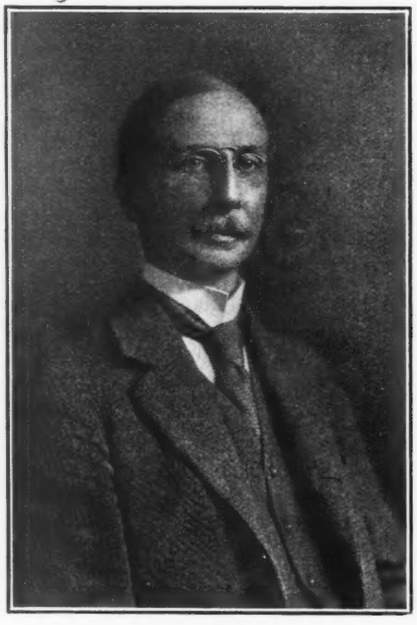
Tribute Paid to His Distinguished Service in the Literature of Mining

About ninety persons attended a dinner arranged by the Mining and Metallurgical Society of America to do honor to Prof. Robert Peele at the Aldine Club on Thursday evening, April 26, 1923. They ranged from professional acquaintances to former students and from intimate friends to engineers who knew the professor chiefly through his Handbook. All of them united in paying tribute to his widely used work and to the position he occupies in mining circles. In one respect the occasion had a military flavor, for the principal event of the evening was a presentation of a D. S. M. to the professor, a gold medal for distinguished service in the literature of mining.

Carl A. Meissner acted as toastmaster. As he rose, tinkling a glass to call the diners to order, a former medallist, E. P. Mathewson, also rose and asked the question, "Who put the 'P' in Peele." At which much laughter. The toastmaster read a carefully prepared speech, pointing out, among other things, that the "Mining Engineers' Handbook" was also a book of entertainment, and had been used as such by engineer officers in the A. E. F. on their return home from France when reading material was scarce and all sorts of expedients had to be devised to pass away the time. Mr. Meissner stated that too often tribute is paid a man after he is dead, and that it was a great pleasure to do so while the tributee was alive. He was strong in his praise of the man and his works.

W. Y. Westervelt, who followed Mr. Meissner, delved into the career of Professor Peele, carrying his listeners from the time when, as a boy of eight, Robert Peele began mining in the cellar of his home to the moment of his presence at the dinner that night. One of the many interesting facts he related was a reference to the painstaking labor involved in compiling and editing a handbook. He said that Professor Peele had read the book an equivalent of five times and that the work seemed destined to become a handbook common to all the engineering professions because of its broad treatment of engineering principles.

The next speaker to be introduced was John A. Church, who spoke warmly as a former student and related the methods used by the professor in the classroom, his logical and point-to-point presentation of the subjects on which he lectured, and the respect the students had for him, not only while undergraduates but also after beginning professional work.



Robert Peele

The actual presentation of the medal was delegated to B. B. Gottsberger, who acted on behalf of Mr. Rogers, the president of the society. Mr. Gottsberger referred to the criticism to which the engineer was subjected for not occupying a more important position in the affairs of the country, and stated that it was necessary for the engineer first to serve the industry in which he happens to be engaged before broadening his sphere. He eulogized the work of Professor Peele in compiling and coordinating the mass of data required to write a technical handbook, and admitted that the "pen was mightier than the pick and shovel."

Professor Peele said that he had been experiencing the most embarrassing time of his life and that he could not adequately thank the society for the honor it had bestowed upon him. He modestly gave credit to the many contributors of the handbook for any merit it possessed and stated that enough copies had been sold to build a stack about three-quarters of a mile high.

California Mining Men Meet

The department of mines and mining of the Sacramento Chamber of Commerce held a meeting on April 20, 1923, at Sacramento, Calif. Mine superintendents and mine owners from the Mother Lode district were present.

Channing Talks at A.I.M.E. Meeting in Washington

Senator Oddie Will Introduce Bill for Department of Mines

Legislation providing for the establishment of a federal Department of Mines will be introduced at the next session of Congress by Senator Oddie, of Nevada. Senator Oddie made this announcement on April 27 at a meeting of the Washington Section of the American Institute of Mining and Metallurgical Engineers.

J. Parke Channing, of New York, delivered the address of the evening. His talk was a story of his own personal experiences during the last thirty-five years. He dwelt mainly on the incidents in his life of more than usual human interest. He painted a picture of the hardships and of the pleasures of the early years of his experience in the West, and he drew frequently upon his fund of amusing stories. The only moral which he attempted to draw from his remarks was that in new enterprises one should rely on experience rather than attempt too much pioneering. This does not mean that tried methods should not be applied to situations in which they are new. To illustrate, he cited an experience of his own in Tennessee where a property had been shut down for thirty years. He was able to open it successfully by applying Lake Superior methods of mining and Montana methods of smelting.

Zinc Institute Announces Next Annual Meeting

The fifth annual meeting of the American Zinc Institute will be held at the Hotel Chase, St. Louis, Mo., on May 7 and 8. The tentative program of the committee on arrangements is said to be one of the best that has ever been prepared. Hotel reservations should be made now through R. M. Roosevelt, Hillsboro, Ill.

Geological Survey in Need of Editorial Assistants

In an effort to recruit the editorial force of the U. S. Geological Survey, an open competitive examination for editorial assistant will be held at various places throughout the country on May 23. Vacancies in the Geological Survey at $1,800 to $2,400 (plus bonus) and in positions requiring similar qualifications will be filled from the results. Applicants should apply at once for Form 1312, stating the title of the examination desired, to the Civil Service Commission, Washington, D. C.

MEN YOU SHOULD KNOW ABOUT

S. A. Knapp, of San Francisco, is in New York.

Oliver E. Jager, of the British America Nickel Co., was in New York last week.

E. T. McCarthy has left London to examine the French concession in Korea; he is due at Kobe on May 16.

W. H. Blackburn, general superintendent for the Tonopah Mining Co., of Nevada, was in New York on April 25.

Carl O. Lindberg has sailed for the Orient, where he will be engaged in professional work for the next three months.

Forest Rutherford, consulting mining and metallurgical engineer, announces a change of address to 50 Broad Street, N. Y. City.

T. E. Siebenthal, formerly of Crosby, Minn., has been appointed superintendent of the York mine, a property of the Coates & Tweed Co.

Kirk Bryan, of the U. S. Geological Survey, has begun the geological portion of the investigation being made by the Federal Government of the Columbia Basin project.

C. Mason Farnham has returned to Barre, Mass. He has devoted the last two and a half years to the study of the diamond and copper mines of Central and South Africa.

J. Carson Agnew has resigned his position as assistant to the president of the Midvale Steel & Ordnance Co., and is now organizing a company to deal in iron ore, pig iron, and coal.

J. Q. McNath, mining engineer for the Colorado Fuel & Iron Co. at Canyon City, Colo., was elected president of the Rocky Mountain section of the Mathematical Association of America.

D. C. Jackling has been elected president of the Chino Copper Co. to fill the vacancy caused by the death of C. M. MacNeill. Mr. Jackling has been vice-president and managing director of the company.

Paul Lincoln, who has been manager for the last nine years of the Noble Five mine, at Sandon, B. C., has recently moved to Salt Lake City. Mr. Lincoln will retain his connection with the Sandon property.

W. R. Doell, chief engineer for Clement K. Quinn & Co. at their properties near Crosby, Minn., has been made superintendent of the Shada mine, at Nashwauk, Minn., a property operated by the same company.

Marion E. Rhodes, who served during the last Congress as chairman of the Committee on Mines and Mining, has been appointed assistant to the Comptroller General of the United States. In his new position, his duties will be exclusively legal and of a semi-judicial character.

At the suggestion of Herbert Hoover, the President has appointed **George K. Burgess** to be director of the Bureau of Standards. Since 1913 he has been chief of the Bureau's Division of Metallurgy. His service with the Bureau, however, dates from 1903.

Mr. Burgess was born in Newton, Mass., in 1874. He received his B.S. from Massachusetts Institute of Technology in 1896, and held a fellowship at that Institution from 1898 to 1900. His Sc.D. was obtained in Paris in 1901. He served short terms as instructor at the University of Michigan and at the University of California. Mr. Burgess served the Bureau of Standards from

George K. Burgess

1903 to 1905 as an associate physicist. From 1905 to 1913 he served as a physicist and in the latter year was raised to the rank of chief of division. Mr. Burgess has been active in the work of the National Research Council. During the war, in addition to his regular duties, he was an advisor to the requirements division of the War Industries Board and to the Ordnance Department of the Army. In 1917 and 1918 he was chairman of the light alloys committee of the National Advisory Committee for Aeronautics. During the same period he was a member of the National Aircraft Standards Board. He was the recipient of a silver medal at the Pan-American Exposition held in 1915.

Roy H. Elliott, late manager of the western activities of The Metals Exploration Co., has established an office at 1,200 First National Bank Building, San Francisco, and will practice as a consulting mining engineer.

O. E. Meinzer and **D. G. Thompson** are conferring with State Geologist **H. B. Kummel,** of New Jersey, for the purpose of arranging plans for an investigation of ground-water supplies in certain industrial areas of that state.

A. W. Crosby has resigned as general superintendent of production and drilling for the Sinclair Oil & Gas Co., Houston headquarters, and will re-enter the business of contract drilling. **J. E. Hooper,** field manager at Damon Mound, will succeed Mr. Crosby.

Adolph Knopf has been made professor of physical geology and petrology at Yale University. **Charles Schuchert,** professor of paleontology and historical geology at Yale since 1904, and **Horace L. Wells,** professor of analytical chemistry and metallurgy since 1893, will retire from active teaching this June.

Henry M. Rives, secretary of the Nevada Mine Operators' Association, left Reno, Nev., on April 21 for Washington, D. C. He goes as the representative of Nevada silver producers to confer with Senators Pittman and Oddie, the Director of the Mint, and the Senate Silver Commission. Later he will visit New York.

Stanley R. Moore, mining engineer, has returned to Wallace, Idaho, from Guanajuato, Mexico, where he had for several years been superintendent of mines for the Guanajuato Mining & Reduction Co., an American corporation. Before going to Mexico he was superintendent of the Success mine in the Coeur d'Alene district.

Sidney Paige has been transferred to the Alaska branch of the Geological Survey as geologist in charge of three parties that will make a survey this summer of naval petroleum reserve No. 4 on the Arctic coast of Alaska. His transfer took effect May 1. **James Gilluly** has been transferred from the geologic branch to the Alaskan branch to assist in the petroleum survey.

Frank Botsford, district manager of the Western Mesabi Range for the Pickands-Mather Co., has assumed the general managership of the Mahoning Ore & Steel Co. Mr. Botsford succeeds **W. C. Agnew,** who will devote most of his attention to the operations of the Rogers-Brown Iron Co. **H. S. Wollan,** who is at present superintendent of the property, will continue in that capacity.

L. C. Shattuck, general manager of the Shattuck Arizona Copper Co., was elected president of the company at a recent meeting of the board of directors held in Bisbee. Mr. Shattuck will continue to act as general manager. **T. O. McGrath,** who has been auditor for the company for many years, was elected assistant general manager, and **Joseph Walker** was made mine superintendent.

Roy Marcellus, of Hobart, Tasmania, accompanied by Mrs. Marcellus, recently arrived in Wallace, Idaho. Mr. Marcellus is a mechanical engineer, and for the last six years has been connected with the Australia Electrolytic Zinc Co. at Hobart. He is now with the Hume Pipe Co. and is on his way to London, the headquarters of the company. He expects to return to the United States in June and to sail soon thereafter from San Francisco to Australia.

THE MINING NEWS

The Mining News of ENGINEERING AND MINING JOURNAL-PRESS is obtained exclusively from its own staff and correspondents, both in the United States and in foreign fields. If, under exceptional conditions, material emanating from other sources is published, due acknowledgment and credit will be accorded.

Leading Events

MANGANESE mining in the Batesville-Cushman district in Arkansas is being revived. Both large and small operators are producing to fill contracts with steel companies.

The American Smelting & Refining Co. has raised wages at Leadville to meet the scale paid in other mines.

W. R. Allen and associates have been indicted for fraud in connection with Boston & Montana manipulations.

Reports state that tenders are asked to supply machinery for a mill to be built at the Katherine mine, near Kingman, Ariz.

Plenty of power is now available for the mines of northern Ontario.

A novel law passed by the Colorado Legislature provides for joint owners of mining claims to develop them independently; it protects the interests of all.

A Butte man has patented a device to concentrate ores by electric induction. Tests are said to show excellent results.

The Mogollon Mines Co. has started the development of the Fannie mine, the property of the bankrupt American Silver Corporation at Mogollon, New Mexico.

New customs mill will help silver producers in the Tombstone district in Arizona.

Senator Pittman, at Washington, has addressed a vigorous protest to the Under Secretary of the Treasury in respect to revocation of silver allocations.

Novel Law Permits Joint Owner to Mine Independently

Measure Passed in Colorado May Stimulate Opening of Mining Property —Rights of Partners Defined

Of outstanding importance to the metal-mining interests of Colorado is H. B. 553, which was enacted by the Colorado Assembly during the late session, and which has been signed by Governor Sweet. It provides that where two or more persons have joint ownership in a mine they shall be considered tenants in common, and any one of them shall have the right to develop or work the property without the consent of any non-working owner, subject to an accounting to the non-working owner or owners for his proportionate share of the net profits, if any. The working owner or tenant is permitted to set off against the proceeds of operation all expenditures and expenses of the work, including the building of roads, installation of machinery and equipment, and reasonable compensation for his services. He is also allowed a set-off for expenses incurred in prospecting, when carried on in good faith.

The working co-owner or tenant cannot demand contributions of non-working owner except out of proceeds of net profits, and no lien can be created or attach to the interest of a non-working owner, but only to the interest of the working owner or tenant.

Any owner or tenant in common is given the right to lease his interest, and his lessee is entitled to all rights and benefits, and is subject to all duties and obligations, of a working owner or tenant.

The measure seems to include ample provisions for the protection of both working and non-working owners, and it is believed will result in the opening up of many old properties in Colorado which have remained idle because a fractional owner would neither dispose of his interest at a reasonable figure, or join with co-owners in working or leasing the joint holding to a third party.

Asbestos Miners Deport Manager at Thetford Mines

Striking Employees Resent Presence of Armed Guards

C. H. McNutt, resident manager for the Asbestos Corporation, at Thetford Mines, Quebec, was taken from his bed and escorted to the train for Sherbrooke by 1,500 striking miners on April 25. The superintendent for a construction company was accorded the same treatment. Forty armed constables or detectives had entrenched themselves in the company's offices. A mob attacked them with stones and a fire hose, forcing them to flee after blank shots fired over the heads of the miners had failed to check the charge.

With the departure of the detectives quiet was restored. Miners employed by the Asbestos Corporation have not returned to work, but men from neighboring mines, who went out in sympathy when the constables appeared, were back in their pits the following day. Officials of the company appealed to the government for protection.

New Corporation Will Take Over Mining Properties in Parral

A. S. & R. Will Direct Operations in Mexico—McQuatters Holdings Included

The Mexican Northern Mining & Railroad Co. has been organized under the laws of Delaware to take over the Mexican properties of the Alvarado Mining & Milling Co., its option on the Parral & Durango R.R., certain timber holdings, as well as all properties of the Refugio Mining Co., Hidalgo Mining Co. and the San Juanico Mining Co. and sundry silver mines near the American Smelting & Refining Co.'s Veta Grande property in the Parral mining district in Mexico.

The capital will consist of 15,000 shares of 7 per cent preferred stock, 5,000 of which will be issued, and 1,000,000 shares of common stock of no par value, 600,000 of which will be issued. The American Smelting & Refining Co. will own 2,500 shares of the preferred stock and 70,000 shares of the common stock.

The officers of the new company will be H. A. Guess, president; F. H. Brownell and William Loeb, Jr., vice-presidents; J. C. Emison, treasurer, and J. C. Dempsey, secretary. Besides Messrs. Guess, Brownell, and Loeb, the directors are A. J. McQuatters, Gordon Dexter, John R. Hall, Louis E. Stoddard, H. A. Prosser, and C. L. Baker. Five of these are officials of the American Smelting & Refining Co., which will have control of the operations of the newly created company.

Manganese Mining in Arkansas Revives

Operations in Batesville-Cushman Field Resumed—Both Large and Small Operators Busy

By Tom Shiras

THE activity in steel has put new life into the Batesville-Cushman manganese field, in Arkansas, and production is increasing rapidly. Since 1917 the industry has been practically at a standstill, only a few properties running, with light production. Every miner in the field is at work now, and new properties are starting up as they can be manned with the necessary labor forces.

There is a marked contrast in the work in progress now and that during the war. Then it was one big rush. Properties were purchased with but little investigation; high-priced machinery was rushed in, and almost any price paid for labor; everything was hurly-burly. Today every operator is feeling his way and figuring costs carefully and conservatively.

The operators who stuck during the last lean five years now have contracts for 18,000 tons to be delivered to the furnaces, with as much more as they can produce in excess of this.

The ore is divided into two grades. Class A, which covers everything from 40 to 52 per cent, and Class B, which covers everything from 25 to 40 per cent. The contract price on Class A is 55c. per unit. On Class B, the price scales from 38c. per unit for 25 per cent to 46c. per unit for 40 per cent. It is expected that if the price of manganese ore advances on the market the furnaces with which these contracts are made will also advance the price. These prices are much below those paid during the war, when 52 per cent ore sold for $1.26 a unit, and 40 per cent at $1.02. No big profits will be made at the present prices in the Arkansas field, but with conservative costs most operations should show a small profit. The group of operators which constitute what might be termed the "old guard," men who have their homes in the field and who have mined manganese for years, who have the present contracts, are apportioning the tonnage among all operators who care to start operations.

Labor is scarce in the field and will probably be scarce until after the first of June, when crops are laid by. Then the native farmers who are also miners will go into the pits and tunnels again.

Many small operators who formerly recovered only lump ore are now washing the fines in hand jigs and small washers and sluices, introduced by "Silicate" Bill Jones, who showed the manganese miners that they were losing half of what they produced, all for the lack of a little knowledge and ingenuity. At first they didn't believe it would work, but after he had cleaned up several rich dumps they accepted his method and have been using it ever since. The fine ore occurs mixed with the clay. The whole is sluiced, or run through a small screen pulled by a small gasoline engine, and the clay is washed out. The concentrates from this process are then run through a hand jig for final cleaning. These small plants can be moved to a new site in a day, with one team.

The Eureka mine, operated by the United States Manganese Ore Corporation, has lately added jigs to its washing plant, which has increased its production and made it possible to produce a better grade of ore.

The Southern Hill, operated by the same concern, is making a nice production at this time, and is driving a development tunnel clear through the base of the hill in which the ore occurs. This is the most important development ever started on this property. The hill at the apex is 80 ft. high and 800 ft. through at the base.

The company contemplates the laying of a pipe line three miles long from Polk Bayou in the near future, and equipping the property with a large washing plant.

The Shell-Adams properties are all producing. The work is all by contract, and the washing is done on hand jigs.

The American Manganese Co., which took over the Independence Mining Co.'s properties several years ago, is starting operations. The Polk-Southard is the biggest producer in this group. It is equipped with a washing plant with a capacity of 250 tons a day, and two steam shovels.

The American Ore Corporation, of Duluth, Minn., has recently started operations on a 340-acre tract eight miles east of Cushman. At the present time the operators are handling wash dirt over hand jigs, but are considering the erection of a washing plant this summer.

The Northern Minnesota Ore Co., of Deerfield, Minn., which recently took over the Aydelot property, one and one-half miles east of Cushman, has started operations.

The Bee Rock Mining Co., operating the Roach mine, six miles northeast of Cushman, is purchasing equipment for a washing plant. The plant when completed will handle 300 tons daily.

The White River Manganese Co., operating three and one-half miles east of James Switch, is setting a new boiler to provide additional power for its washing plant, which has a capacity of 400 tons a day. The company will start its plant as soon as the boiler installation is completed.

Operators believe that the future of the field will depend on the ability to fill present contracts in the stipulated time. If this can be done, a steady market will be assured.

Small manganese enterprise in Arkansas

Krull Eludes Bandit Captors in Mexico

A dispatch from Mexico City states that Oliver W. Krull, the American mining engineer, manager of the La Cruz mine, near Velardeña, Mexico, who was kidnapped on April 6, escaped from the bandits who held him prisoner at a placed called Coeta, State of Durango, according to a story he told upon his arrival at Gomez Palacio.

Krull's narrative was relayed to Mexico City newspapers on April 26. He said he was well treated after his capture, although he suffered from cold and hunger on the long forced marches through the mountains. The kidnappers, headed by Juan Galindo, the Coeta outlaw leader, first attempted to force Krull to appeal to the United States Government for a ransom of $100,000, according to Krull's story.

Lessees, With Noses for Ore, Make Mine of Argentine

Coeur d'Alene Property Revived After Twenty Years—"Practical" Miners Did It

Leave it to leasers to find ore where others with more pretentious qualifications fail. For twenty years the Argentine mine, one of the early locations in the Coeur d'Alene district, Idaho, has been idle and all but forgotton, its old gravity tram rotting away and new growth of underbrush concealing its old dumps and portals to caving tunnels. Former operators had abandoned it. Today a carload of ore that returns 40 oz. of silver to the ton is being shipped daily from the Argentine to the smelter. In a drift from the bottom of a 200-ft. shaft sunk from the main tunnel an oreshoot has been followed for 50 ft. which averages 5 ft. wide, practically all siderite with gray copper distributed through it. Samples run as high as 300 oz. in silver and the entire mass averages 40 oz. Steps are being taken to sink the shaft 200 ft. further and plans are also being formulated to open the oreshoot at an additional depth of 800 ft. by drifting from a neighboring property, which would also provide a desirable outlet for the mine near the railroad track. A new tramway more than 2,000 ft. long has been built, which delivers the ore direct from the tunnel to the railroad cars, and an electric hoist has recently been installed.

Conditions indicate that the old Argentine is entering upon a career of large and profitable production. All this has been accomplished within the last year by a group of Kellogg leasers, all of whom are practical miners except one, Milton W. Emmett, a young lawyer, who looks after the business features of the enterprise.

1,000-Bbl. Shale-Oil Plant Would Cost $3,190,000

Martin J. Gavin, refinery engineer for the U. S. Bureau of Mines, estimates that a Scotch oil-shale retorting plant capable of receiving shale from the mine, producing from it 1,000 bbl. of crude oil and a corresponding quantity of finished ammonium sulphate, per day of twenty-four hours, and disposing of the spent shale, would cost approximately $2,190,000. A refinery capable of completely refining 1,000 bbl. of crude petroleum per day would cost about $1,000,000; a complete shale-oil refinery probably more. Thus a complete plant of the Scotch type capable of treating 1,000 tons of 42-gal. oil-shale per day, and making a complete line of finished products, including ammonium sulphate, would cost about $3,190,000. This figure does not include cost of land for plant site, mine, mine equipment, opening up mine, land for spent-shale dump, camp for workers, and the like. It does include complete retorting and refining equipment, ammonium-sulphate works, and auxiliary buildings and equipment.

Bolivian Company Installs Holt-Dern Roasters

The Compania Beneficiadora San Vicente de Bolivia in Bolivia is installing two Holt-Dern roasters in its new milling plant. The company will use the same process as that which is proving so successful in the plants of the Tintic Milling Co. and the Tintic Standard Mining Co. both of which are situated in the Tintic district of Utah. After a chloridizing roast the valuable metal-bearing salts are leached, before precipitation. The process and the roasting equipment were developed in Utah.

Done in Jig Time!

The Butte-Kansas Mining Co. closed down its mill in the Waco field, in the Joplin-Miami district, at the end of the night shift, Friday, April 20, on account of two leaking rougher jigs. Workers tore out the old jigs completely and built new ones, using more than 8,000 ft. of lumber and 500 lb. of nails in each jig, and the plant was ready to run again by Monday night, April 23.

The company is driving an air drift connecting its shaft on the south side of the lease with the one on the north side, which will improve ventilation.

Tombstone Needs No Obituary Yet, Think Operators

New Custom Mill in Arizona Camp Will Make Mining Profitable, Even on 65c. Silver

That the completion of the government purchases of one-dollar silver has not shattered the mining possibilities of the Tombstone district, in Arizona, is the conviction of V. G. Melgren and his associates, who have just completed a new 50-ton mill on the Bonanza property. The Bonanza consists of fifty-two claims owned by J. L. Melgren and his son, V. G. Melgren, and has been leased to Wooton, Hilton & Jacobson.

Mining now has been in progress for many months, the ore being stocked awaiting the completion of the cyanide plant. The mill is now treating 30 tons per day and is making a recovery of 92 per cent. It is planned to treat custom ores of the district, and the owners expect to have the plant operating three shifts in the near future. It is believed that a large tonnage is available from the many prospects in the district that can be profitably mined for treatment in the new plant, even though it would not stand freight to a smelter.

Proposal to Test Old Gold Fields in Coolgardie

By Cable from Reuters to "Engineering and Mining Journal-Press"

Melbourne, April 27—The Coolgardie Leaseholders and Prospectors' Association has asked the West Australian Government to subsidize the testing of old gold fields in the Coolgardie district.

A. S. & R. Subsidiary Finally Raises Wages to Meet Scale

Strike Against Yak Company at Leadville Ends After Four Months—Prospects Are Good

E. L. Hartwell, manager of the Yak Mining & Tunnel Co., a subsidiary of the American Smelting & Refining Co., which is operating at Leadville, announced that, effective May 1, the minimum wage for underground work would be advanced from $3.50 to $4 per day; machine men to receive $4.50 instead of $4. These are the rates established by the other companies in the district several months ago.

In connection with the strike on the property and the new wage scale, Manager Hartwell said:

"The decision of the company to increase the minimum wage to $4 a day for all underground work was made upon the development of the orebody the past week, which showed to be bigger and better than was at first hoped for. Considerable work will have to be done at the Dolly B, and it will be two or three months before the Yak company realizes anything in return from the new find, but it has developed so well and looks so promising that it was decided to give the men the increase in wages."

The announcement of the $4 minimum scale automatically ends the strike. which was called by the Leadville union the first of the year. Despite the strike, the company continued to work the property, and carried on development work in sinking a 180-ft. winze and driving a crosscut to the recent strike. The discovery was in the white-lime horizon below the tunnel level, and is a new development in the possibilities of the white-lime contact. This is the first work in the district in the white-lime measures, past production having come from the blue-lime horizon, and the discovery appears to open up a new field of promising value.

Following the announcement of a new wage scale, the Fortune Mining Co. announced the resumption of work on its property, which was closed down March 22, following difficulties with the local union over the use of air supplied by the Yak company.

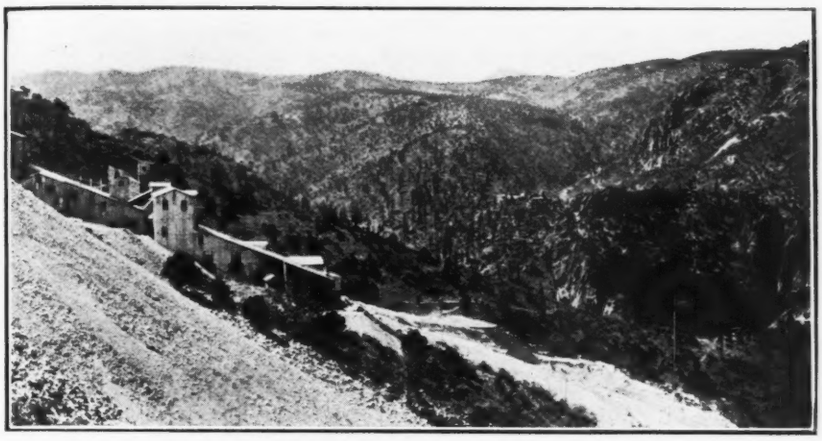
Governor Ousts Officials of Miami School of Mines

Considerable interest was aroused in the Joplin-Miami zinc-lead district by the sudden ousting of the board of regents for the Miami School of Mines by Governor Walton of Oklahoma without warning. There was talk of resisting his order, but legal advisers declared the Governor had acted within his rights, so the regents who had served since the founding of the school have turned over the records to the new members. It is announced that W. O. Cralle, who has been president of the school, will be retained until June 1, after which he will be succeeded by Representative G. W. Moothart.

Mogollon Mines Co. Starts Development of Fannie Property

Has Mine Under Working Agreement With American Silver Corporation—Fannie Has Good Record for Production

S. J. Kidder, manager of the Mogollon Mines Co., of Mogollon, N. M., has lost no time in getting operations under way at the Fannie mine, recently taken over under a working arrangement with the receiver of the American Silver Corporation.



Fannie mill, near Mogollon

The accompanying illustrations give an excellent idea of the conditions surrounding the properties. In the center is the mining camp of Mogollon, or rather a glimpse of the main business street. The town has a population normally of perhaps 1,000, the home section being in the surrounding hills. Although situated at an altitude of 7,000 ft. the water supply is good. The Gila national forest surrounds the camp. A quarter of a mile to the east is the Mogollon company's property, which has been in active operation for many years. A little further west is the Fannie mine, and it is joined on the west by the Alberta property, which will be worked through the Fannie levels.

The Fannie has a record of having produced nearly $5,000,000 and has about 30,000 ft. of underground workings. The property is also equipped with a mill. The present owners have never been able to operate at a profit, but more efficient management is expected to make it pay. Overhead will be cut down by co-ordination with the Mogollon operations.

Immediately on taking over the Fannie, Mr. Kidder started to assemble a force, and by April 10 had secured the men required to undertake the initial opening and development work. The wage scale for the camp is $3.75 to $4.25 for machine miners, $4.25 for timbermen, and $3.25 for trammers—the eight-hour day prevailing throughout.

Frank Hitchcock, former postmaster, is president of Mogollon Mines Co. He has recently been in New Mexico looking after the affairs of the corporation.

Construction Plans Based on Dollar Silver, Say Nevadans

Henry M. Rives, secretary of the Nevada Mine Operators' Association, has been instructed to proceed to Washington, as a representative of the association, to appear before the Senate committee at hearings investigating the gold and silver question. One of the principal metals produced in the state is silver, and mine operators are naturally anxious about the future of silver. They are especially interested in the recent decision of the Director of the Mint to allocate over 10,000,000 oz. of silver used for subsidiary coinage to Pittman Act purchases. This amount of silver means about two months' extension to the period of dollar silver, and had been counted on until the belated "decision" of the Director of the Mint was made public. It was therefore, say mine operators, a factor in construction programs engaged in by several companies in the state during recent months. To some of these companies at least a little advance information on the subject might have resulted in a change in plans, and a difference between probable loss and probable profit. Mr. Rives will co-operate with other producers in an effort to have the ruling reconsidered by the Treasury Department.

Butte Inventor Patents "Induction Separator" for Ores

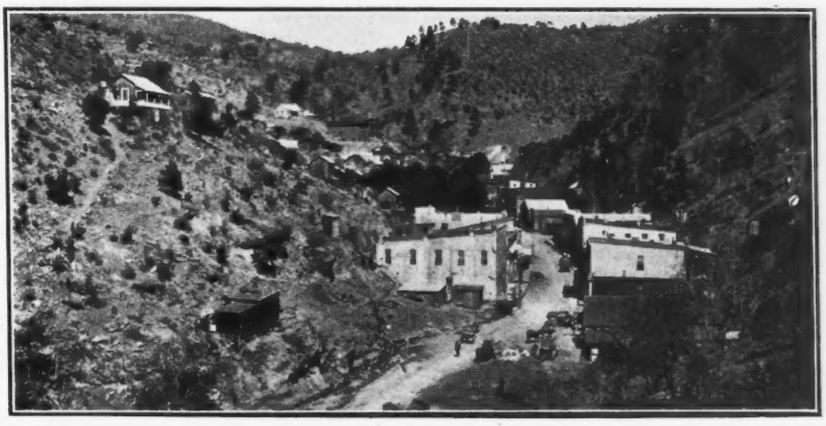
Claims Tests Convince Manufacturers of Merit—Will Cut Cost of Treating Low-Grade Ores, Says Backer

Willard C. Hall, twenty-four, of Butte, Mont., has obtained basic patents on an apparatus for the separation of diamagnetic minerals from ores by a process of induction which his backers declare will do much for the mining industry.

The process is said to be cheaper than oil flotation, and has added advantages. The induction separator, according to the statement of H. J. Meiser, president of the Hall Mineral Separation Company, not only separates the mineral from the ore but classifies the different valuable minerals contained in the rock.

The machine, declares Mr. Meiser, will be manufactured by the Dings Magnetic Separator Co., which, with representatives of the Allis-Chalmers company, tested the Hall apparatus last fall. At this trial hematite ores from the Mesabi Range in Minnesota were used. Apparently the tests were satisfactory to the representatives of both companies, as Mr. Meiser declares the Dings company immediately asked for the exclusive rights in manufacturing Hall machines.

According to Mr. Meiser, the machine will do much toward making the mining of low-grade ore profitable. Electrically operated, the machine is neither static or magnetic, but works, as its name implies, through induction. Either wet or dry ores may be separated by the apparatus. The cost of operating, asserts the president, is low in comparison to some of the methods now in use.



Camp at Mogollon, N. M.

Mexican Metal Statistics

The metal production in Mexico for the month of February is reported by government officials in Mexico City as follows, in kilograms:

Gold, 1,897; silver, 219,831; lead, 11,797,954; copper, 3,983,666; zinc, 1,031,273; mercury, 3,615; arsenic, 40,504; graphite, 445,403.

$10,000,000 Bond Issue Will Finance New A. S. & R. Plants

Zinc and Copper Smelters Will Be Erected in Mexico—Coal Properties Developed

An issue of $10,000,000 American Smelting & Refining Co. 6 per cent first-mortgage gold bonds, due April 1, 1947, has been offered by a syndicate including Kuhn, Loeb & Co., the Guaranty Company and the Bankers Trust Company. Including this issue, known as Series B, there will be a total outstanding of $52,477,700 first-mortgage bonds, of which $42,477,700 are 5 per cent bonds. The new bonds were offered on a basis to yield slightly more than 6 per cent.

The following is quoted from a statement issued by the company regarding the new bond issue:

"The company is planning immediate extensive developments and additions to its properties, particularly the installation at its Rosita coal mine of a modern mining equipment having a producing capacity of 50,000 tons of coal per month, and the erection of byproduct coke ovens of 15,000 tons' capacity per month, this capacity being a conservative estimate of the company's requirements in its own operations. About 30,000 tons of coal per month will be required for coke and the remainder will be available for commercial purposes.

"In addition, the company is contemplating the erection of a new copper smelter and a zinc smelter in Mexico, as well as the acquisition of a substantial interest in and the operating management of important new Mexican mining properties.

W. R. Allen, et al., Charged With Fraud in Boston & Montana Case

Indictments charging conspiracy to defraud stockholders of the Boston & Montana Corporation, owner of mining and milling property in Montana, was returned in Boston on April 22. Besides W. R. Allen, president, the following were named in the indictment: William Howard Montgomery, an officer of the American Discount Corporation of Boston; Lee George, a son of the late Judge Elijah George of the Suffolk County Probate Court, and connected with the American Discount Corporation; Hamilton B. Wills, of New York, of Hamilton B. Wills & Co., brokers of New York and Toronto; Harry G. Perch, of Boston; George Gallup, former Judge of the Circuit Court of Michigan, and his son, Charles E. Gallup; Nathaniel E. Flanders, of Boston; Samuel Usher, 2d, of Cambridge; William J. Bershaw, of Beverly; Francis Sullivan, of Boston; Robert M. Currier, of Westwood; Charles F. Cowdrey, of Boston; H. Carleton Slack, of the Boston stock brokerage firm of Allen-Slack Co.; Seth T. Gano, of Belmont, and John H. Burnham, of Boston.

The company raised money for the opening of a mine and the building of a costly mill.

Canada Feels Pinch of Arsenic for Farmers

Manufacturers of insecticides have sent a representative to British Columbia to examine a number of mining properties containing arsenic. A good deal of arsenopyrite associated with gold occurs in the Boundary district, the Nickel Plate mine always having sold a considerable amount of the mineral in the form of a concentrate, obtained as a byproduct of gold-milling operations. Among the properties that are to be examined are the Aufes group, near Hope, and a mine at Bridge River.

Last year native arsenic was found at several points on the Queen Charlotte Islands. The metal is found distributed unevenly through the rock, some of the pieces being as large as a hen's egg. As there was no great demand for arsenic at the time, and as the ore contained no other mineral of value, a thorough investigation of the discovery was not made. Recently, the Saskatchewan Government endeavored to purchase 400 tons of arsenious oxide in the United States, but found that there was not sufficient to supply the needs of the agriculturists in that country. There is a shortage of arsenic in western Canada.

Rhodesian Gold Output

By Cable from Reuters to "Engineering and Mining Journal-Press"

London, April 28—The output of gold in Rhodesia during March totaled 48,171 oz.

News from Washington

By PAUL WOOTON
Special Correspondent

Misconstruction of Law and Violation of Spirit, Says Pittman

Regards Revocation of Silver Allotments as Unjustifiable—Writes Under Secretary

Under date of April 23 Senator Key Pittman addressed an open letter to the Under Secretary of the Treasury, protesting vigorously against the ruling that allocations of silver for use in the making of subsidiary coins should be revoked, thereby reducing the amount of virgin silver to be purchased from domestic silver producers at $1 per ounce by 12,931,483.74 ounces. After reviewing the entire situation, Senator Pittman declares that in his opinion the Comptroller General has given a wrong interpretation to Sec. 2 of the Pittman Act. In concluding his letter the Senator says:

"It will be observed that the opinion of the Comptroller General holds that it is within the discretion of the Treasury Department as to whether or not it will cancel such allocations. Under the opinion therefore the Treasury Department has authority to coin such silver so allocated into subsidiary coin or to hold it for that purpose.

"Irrespective of the legal question involved, it must be obvious to the Treasury Department that it has violated the spirit of the law and has thereby deceived the producers of silver in the United States to their irreparable damage.

"Not until subsequent to March 30th of this year was any notice given to the producers of silver that such allocations were going to be revoked and that the purchase of American silver under the Pittman Act would be reduced to such extent. On the contrary, the reports theretofore given out by the Treasury Department included such allocations in the amount of silver to be purchased under the Pittman Act.

"I respectfully submit that, without regard to the legal question, it is the moral duty of the Treasury Department to treat such allocations as sales under the Act and to add such amount to the purchases to be made under the Pittman Act."

800 War Minerals Claims Have Been Settled

Assistant Will Succeed Robinson in Closing Up Work—$2,000,000 Left in Fund

The work of the War Minerals Relief Commission will be expedited during the coming eight months and completed by the first of January, 1924, according to an announcement made today by Secretary of the Interior Work. Of the 1,231 claims filed by mining interests throughout the country against the government as a result of development of minerals necessary for the conduct of the World War, about 800 of the most important ones have already been settled.

Judge Ira E. Robinson, who has been at the head of the commission for the last two years, voluntarily presented his resignation on April 30, after having served two years and having handled the majority of cases. He will return to his home at Grafton, W. Va., to resume the practice of law.

The War Minerals Relief Commission is now operating under an appropriation of $8,500,000 made by Congress two years ago for the purpose of adjusting mineral war claims, and about $6,250,000 of this sum has been expended. During his service, Judge Robinson disposed of claims running into millions of dollars which presented many difficult questions of law and fact. He had served upon the Supreme Court of West Virginia.

John Briar, who has been acting as assistant commissioner, has succeeded Judge Robinson as commissioner and will proceed to close up the work of the commission.

Pittman Act Silver

Purchases of silver by the Bureau of the Mint during the week ended April 28 amounted to 142,000 fine ounces. This brings the total purchases (including tenders for future delivery) under the Pittman Act to 182,927,584 fine ounces.

News by Mining Districts

By Special Correspondents in the Field

London Letter

Position of National Mining Improves—Knox Reports on Cam and Motor

BY W. A. DOMAN

London, April 19—A considerable improvement is shown in the report and balance sheet of the National Mining Corporation for 1922, compared with that for 1921. But at March 31 last a further appreciation had taken place, and the position then stood approximately thus, assuming that creditors had not materially altered:

Quoted securities	£188,505
Appreciation	147,000
Unquoted securities	414,722
Total investments	£750,227

The unquoted securities are valued by the directors. As regards the value of the assets, the position is:

Shares	£750,227
Loans and interest	116,683
Debtors	59,444
Cash	79,133
	£1,005,487
Creditors	346,540
	£658,947

On the issued shares of 2,477,400, 4s. paid, the above represents 5s. 4d. a share. Of the cash item £68,764 is in foreign currencies, moneys held abroad for the purchase of properties and similar uses. The improvement in the profit-and-loss position may be shown thus:

	1921	1922
Commissions, dividends	£59,462	£32,180
Net loss in investments	76,868	....
Net profit on investments	....	20,461
Debit balance	82,777	....
Credit balance	....	26,408

Again, investments at the end of 1921 figuring in the balance sheet at £1,055,629 showed a depreciation of £639,110, leaving a market value of £416,519. On March 31 last, three months later than the 1922 balance sheet, the investments were quoted at £750,227, a favorable difference of £333,708. The Corporation increased its holding in the South American Copper Syndicate. The British Equatorial Oil Co. will soon make a public issue of shares, and important oil interests were acquired in Rumania.

Dr. Stickney, the geologist who examined the Akim Concession (West Africa) for the Russo-Asiatic Consolidated, has handed in a brief report in which he considers that, as regards alluvial gold, an area 20 miles long by 500 ft. in width and 19 ft. average depth should be systematically tested. As regards quartz reefs, of which so much is expected, a number have been traced and exposed by trenching. One vein was opened for 1 000 ft. showing free gold, a 24 in. width on the hanging wall assaying 1 oz. of gold per ton over a length of 200 ft. These results are considered encouraging. A certain well-known engineer who has examined technical reports upon the Akim Concession points out that though the lode occurrences are worth testing, working costs are likely to be high, owing to the rapid deterioration of machinery and plant.

The report of Henry H. Knox, who inspected the Cam and Motor Mine (Rhodesia) for the Russo-Asiatic Consolidated, has been handed to the Cam and Motor Co., which has issued a circular to the effect that the document confirms the conservatism of the statements made by the management of the mine. J. H. Curle has also examined the property, and although his report is not published, it is said that his views are most encouraging, and that he is of opinion a bonanza has been struck.

A rumor is current in the market here that the Spanish and Portuguese copper producing companies are arranging a plan to pool their production of sulphur ore instead of competing with one another. The companies involved are the Rio Tinto, Tharsis, Mason and Barry, Peña, and Huelva.

Johannesburg Letter

New Gold Reef in N. E. Transvaal—Reduced Wages Saved Nineteen Mines

BY JOHN WATSON

Johannesburg, March 27—The discovery of a new gold reef is reported from Leydsdorp district (N. E. Transvaal). A five-stamp battery has been crushing since Feb. 10, and a yield of 107 oz. of gold on the plates is reported from 194 tons of ore.

A Krupp ball mill is in course of erection and a tube mill is on order. Dr. Kassner, a well-known geologist and traveler, has recently spent three weeks in examining and reporting on the new reef. He is satisfied that the reef is of vast importance. The third lot of check samples taken on Feb. 21 gave the following:

No. 1, on footwall, over 10 ft.	16 dwt.
No. 2, next to footwall, over 5 ft.	12 dwt.
No. 3, next to footwall, over 5 ft.	18 dwt.
No. 4, on hanging wall, over 10 ft.	15 dwt.

The average is said to be 15.5 dwt. over 30 ft.

The Union Corporation, Ltd. (formerly Ad. Goerz & Co., Ltd.) has just declared Dividend No. 13, (being a final dividend for the financial year ending Dec. 31, 1922) of 16 per cent, or 2s. per share. The previous interim dividend was 8 per cent, or 1s. per share.

The Robinson Gold Mine has been compelled to close down, owing to its sole remaining payable ore being under the municipality's main outfall sewer, which was laid about 1906. The Robinson has crushed since 1888, 11,500,000 tons of ore, for a total output of 5,723,044 fine ounces. The company has distributed in dividends £11,980,938. The present capital of the company is £2,750,000.

The annual meeting of the Transvaal Chamber of Mines was held on March 26. President H. O. Buckle showed that if working costs had remained at their former level no fewer than nineteen gold mines would have been idle by now, and 7,573 white men added to the unemployed. Last January these mines spent £853,000 on wages and stores; hence their closing down would have meant a serious loss to South African trade. Since the termination of the strike, the wages paid to Europeans on all grades on the mines have averaged over £31 per month. The Rand mines make provision for miners who have contracted phthisis and also for their dependants. This amounts to no less than £100 per annum for every white underground employee and represents a capitalized value of over £600 per man. The health safeguards now enforced are so efficient that, of 13,457 miners examined last year, it was found necessary to warn only thirty-nine of the existence of unsatisfactory health. The prevalence of tuberculosis is the lowest on record.

The new mint at Pretoria is expected to be ready for full work in the course of a few months, and gold mining companies will then be able to obtain coined gold here. During the last year the amount paid to the banks for exchange has been about £5,000,000. At present there is being refined at Gormiston a total of over 8,000,000 oz. of fine gold per annum, nearly 60 per cent of the world's gold production. All the refining is done in an eight-hour day. About a million ounces per annum of silver is extracted from the bullion and refined. The refinery is working at a saving, as compared with the same work done in England, and is meeting all capital charges.

Montreal Letter

Power for All Seems Assured—Dome Mines Shares Seem Unduly High

BY ALEXANDER GRAY

Montreal, April 28—Mine operators think the award of the water-power of the Des Quinze Rapids, in northwestern Quebec, to Alexander Fasken, acting in behalf of the Northern Ontario Power Co., means that the whole power situation will undergo revision. The lease granted to the Fasken interests is for sixty years at an annual rental of $80,100. It calls for immediate development. An export tax is imposed upon power exported from the Province of Quebec. Now the question arises as to what this award may amount to in the litigation between Hollinger Consolidated and the Northern Ontario Power Co.

The Des Quinze Rapids are capable of large development. Hollinger has signed up for the Long Sault power on the Abitibi River. As the Northern Ontario people hold that Hollinger is obligated to take all of its power, for the life of the mines, from the Northern

Ontario company, the litigation will be watched with great interest. Out of the controversy benefit to the gold industry will result, for the more power developed the better it will be for the producing and developing mines of Ontario and Quebec.

The financial statement of Dome Mines of Porcupine, accompanying the latest dividend, discloses the strong position of the company, with its issued capital at $4,290,003, redeemed to the extent of $1 per share, and this liquid situation:

Dividend assurance fund	$1,026,839
Loans on call	1,015,000
Bond holdings	1,070,439
Inventories at cost	305,657
Cash on hand	220,246
	$3,638,181

So that, after making profits since the beginning, amounting to $9,425,280, and having $2,080,027 available for dividends, the company need only to have given some idea as to the ore reserves in order to satisfy the most exacting. Assets of $9,310,863 do not conform to the current market capitalization of the issued capital, approximately $18,000,000. For the time being the mining position is said to be adequate for the requirements of the next two or three years, at any rate. The grade of ore being milled at present is among the highest in the Porcupine field.

San Francisco Letter

Electrical Equipment on Mother Lode—Interconnection of Mines Debated

San Francisco Correspondence.

San Francisco, April 24—Alleghany, in Sierra County, has attracted more or less attention by reason of the high-grade ores which are found in small shoots in relatively lean quartz veins. The operations of the Sixteen to One mine and the Tightner have been successful and have encouraged operators of smaller properties. The Contact mine has recently purchased a 10-stamp mill and additional mine equipment. The North Star Mines Co. expended $60,000 on the Rainbow mine during 1922 and has recently encountered rich ore. The coming season promises to be a good one, with more attention being paid to drift and hydraulic mining.

It is of interest to note improvements in mine equipment along the Mother Lode. The Plymouth mine was equipped with motor-driven hoist and compressors when it was reopened. Since that time many of the older properties have been similarly equipped, the last property to supplant steam hoisting being the Central Eureka. The Kennedy mine retained its steam-driven hoist and compressor, operating its mill by water-power. Recently, however, a 2,200-cu.ft. motor-driven air compressor was installed at the Kennedy in place of the steam-driven compressor, and improvements are being made in the hoist, so that it can be changed to a motor-driven hoist in the future. The Argonaut improved its plant several years ago, and hoist, compressors, and mill are driven by motors. Thus the Plymouth, Fremont, Central Eureka, Kennedy, Argonaut, Carson Hill, and Belmont Shawmut are electrically equipped to a large extent.

On April 24, 1923, a hearing was held before the Industrial Accident Commission on the subject of interconnecting the Kennedy and Argonaut mines as a precaution in emergencies. Opinion is divided among mining men as to the advisability of interconnecting mines generally. A bill has been introduced in the present Legislature for interconnection where neighboring mines are within 1,000 ft. of each other. It is evident that blanket legislation of this nature will not help gold mining, as it would greatly increase operating expense. Mines are now under the necessity of providing additional equipment for fire-fighting purposes. Apparently the gold-mining industry is being pinched between excessive zeal in safety first and labor difficulties.

ONTARIO

Power Plentiful at Porcupine

Porcupine mines have received an increase in power, and there is now sufficient to operate the mines at capacity. The three leading producers will be able to treat approximately 7,000 tons a day, the Hollinger treating about 5,000, the Dome 1,200, and the McIntyre 1,000. The McIntyre will now be able to run its enlarged plant at capacity for the first time in its history, and the output from the camp should show a substantial increase. Nothing new has developed regarding the talked-of strike in Porcupine, and it is expected that with plenty of work for everybody less will be heard of it.

Kirkland Lake Active

In Kirkland Lake good progress is being made at the mines. During March the Lake Shore treated 1,932 tons and recovered $40,852, an average of $21.14 a ton. Most of the machinery for the enlarged mill has been shipped, and it is expected that before the end of the present year 300 tons a day will be treated. The Teck-Hughes is proposing to explore its three deepest levels and is adding substantially to its ore reserves. Production in March amounted to about $90,000. Sinking is now being carried on by the Sylvanite, and the main shaft is down 550 ft. It will be continued to at least 700 ft. before a new level is opened. Shareholders of the King Kirkland have ratified an arrangement with the Tonopah Mining Co. of Nevada, which calls for an expenditure of at least $10,000 every three months. If development is successful and $1,000,000 of ore developed, a mill is to be built, the cost of which will be a charge against the profits from operations. The Tonopah will have a 60 per cent interest in the property if it is put on a producing basis. Similar transactions have been consummated with the Wood-Kirkland and the Moffat-Hall.

BRITISH COLUMBIA

Dredge Financed, Says Report

The installation of a gold dredge on Gold Stream, near the confluence of French Creek, in the Big Bend district of which the city of Revelstoke is the center, is proposed by the Cal-Canadian Gold Dredging Co. H. E. Moore, of San Francisco, has secured leases of the ground and is reported to have obtained the financial backing required to proceed with the enterprise.

Concentrator for Babine Bonanza

It is reported that $250,000 has been advanced by Messrs. Trites and Wood, of the Premier mine, for the installation of a concentrator and to provide for further development on the Babine Bonanza, which James Cronin has been working on for several years. Cronin was the operator who brought the St. Eugene mine to the point where it attracted the Canadian Pacific Ry. Co. and subsequently became a large producer. He believes that his northern property will prove a better paying proposition.

MEXICO

Zimapan Produced 1,191,600 Kg. of Silver in 1922

A general meeting of the Zimapan Mining & Smelting Co., recently held at Pachuca, was presided over by Salvador Dominguez, the principal stockholder. The other shareholders are French and Mexicans.

According to the reports rendered, the amount of ore extracted from the mines north of this city in 1922 was 1,657,985 tons, with an average valuation of about 20 oz. silver to the ton and 13½ per cent of lead. The purchase of outside ores brought the total treated to 2,201,964 tons, which produced 1,191,600 kg. of silver, 180,189 tons of litharge, and 92,390 tons of byproducts.

The new railroad projected from Pachuca to Tampico will pass through Zimapan and will be of great benefit to the camp.

Ocampo Property Located

Mrs. Myrtle E. Hale, of El Paso, has located ten adjoining claims in the Ocampo district. They have been recorded as the Golden Treasure. As soon as titles are received it is expected that ore shipments will begin. In the meantime only development work will be carried on.

Veta Grande Increases Holdings

The Veta Grande Mining Co., operating in the Villa Gonzales region south of Juarez, under the direction of Orson P. Brown, has taken up thirty-seven additional claims to the Veta Grande property. Luis Pavon is making the survey and plans for the new property, which has been recorded as the Annex to the Veta Grande. The ores of this region contain silver, lead, and copper. Development is expected to disclose good oreshoots in the new ground.

ARIZONA

Air Receiver Explodes; Wrecks Plant

The explosion of an air receiver wrecked the power plant of the Queen Creek Copper Co. at Superior, and workmen in the building had a narrow escape. A part of the roof and one side of the plant were blown off, and an automobile parked beside the building was damaged.

Copper Queen Operations Expand

The Copper Queen mine now has 200 more men on its payroll than it had one month ago, and proportional increases in numbers employed have been made by other companies operating in the Bisbee district. Four steam shovels are now at work on Sacramento Hill, and two more that are being overhauled will soon be put into use. The first unit of the new Copper Queen concentrator is now operating three shifts, and satisfactory results are being obtained. The other three units of the plant are being completed, and it is expected that all will be operating within ninety days.

UTAH

Tintic Standard Ships Rich Ore

The Tintic Standard has been mining some rich ore on the 800 and 900 levels of its mine near Eureka. Recently a small shipment brought $30,000, and a lot of 65 tons of similar ore shipped during the week ended April 14 will bring net smelter returns of about $52,500. The later shipment ran 1,018 oz. silver to the ton. Another shipment is being prepared, which it is expected will carry about 1,000 oz. There is a small amount of gold in the ore, and not enough lead to warrant recovery.

Shipments from Bingham and Park City

Shipments from Bingham for the week ended April 21 increased from 104 cars during the preceding week to 115 cars. Shippers were: United States mines, 74; Utah Apex, 23; Bingham mines, 9; Montana-Bingham, 9.

Shipments from Park City for the week amounted to 5,395 tons, compared with 5,336 tons the week preceding. Shippers were: Park City Mining & Smelting, 1,735 tons; Park-Utah, 1,798; Ontario, 493; Silver King Coalition, 1,368 tons.

WASHINGTON

Old Dominion Reorganizes

The Old Dominion mine, operating near Colville, has increased its capitalization from $100,000 to $300,000. The plan of distribution to old shareholders will be twenty shares in the new for one of the old. Par value of the old shares was $10 and of the new 50c. The mine has produced some high-grade ore, and recent exploration has disclosed an orebody on which drifts have extended for 100 ft. The mine has been on a self-supporting basis for the last two years. W. H. Linney, of Spokane, heads the company.

IDAHO

Giant Ledge Will Be Developed

A group of Chicago capitalists, headed by H. E. Ball, have purchased control of the Giant Ledge Mining Co., reorganized it under the name of Giant Ledge Syndicate, and undertaken an extensive development program. The property is situated near Murray, in what is known as the North Side section of the Coeur d'Alene district. The old company has sunk a shaft 400 ft. and accomplishd about 2,000 ft. of underground development, resulting in showing considerable lead-silver ore. The new company is now engaged in unwatering the property, and with that done announcement is made that the shaft will be sunk 400 ft. deeper, and in the meantime the drift on the 400 level will be extended southeasterly, where conditions are favorable for the development of ore. Operations are under the direction of John J. Stanford. The property is well equipped with good buildings and necessary machinery and has both water and electric power.

Snowstorm Mill Busy

The Snowstorm Silver-Lead Co., which has recently formed a consolidation with the Montana Morning after a reorganization, has listed its shares on the New York Stock Exchange. With $300,000 working capital, the company has started operations on a large scale at the mine near Troy, Mont. The mill, which has a daily capacity of 600 tons, is being operated. The product is a high-grade lead-silver concentrate free from zinc. A 90 per cent extraction is reported. The company plans the sinking of a three-compartment winze from the 7th level for a depth of 750 ft. with levels at 250-ft. intervals. The ore has increased in value from the surface to the 7th level, and if it maintains its present value profits are assured. The concentrates average 54.8 per cent lead and 26 oz. silver per ton under normal conditions.

JOPLIN-MIAMI DISTRICT

New Derrick for Smith-Davis Company

The Smith-Davis Mining Co. has repaired an old shaft on its Ritz lease, near Tar River, Okla., and erected a new derrick and hopper at the site, for the purpose of getting an increased tonnage of "dirt" for its mill. Numerous improvements and enlargements have been made at the property in recent weeks, and the company has been rewarded with highly profitable operations.

Federal Busy Prospecting

The Federal Mining & Smelting Co. is operating forty-one prospecting drills in the Joplin-Miami district. Most of these drills are at work on leases taken by the company at different points in the Kansas section of the field, but some on a lease in Oklahoma some distance east of the Coyne Mining Co.'s property, south of Hockerville.

MINNESOTA

State Will Collect $900,000 From Owners of Iron Lands

The bill providing for a 6 per cent tax on royalties received from iron-ore lands owned and leased in the state was passed by the present session of the Legislature and was made a law by the signature of the Governor. The original bill called for an 8 per cent tax, but this was amended to 6 per cent. An amendment calling for a 10 per cent tax was defeated. This legislation was recommended by the Minnesota Tax Commission in its last report, and according to present prospects of an active season, the tax on royalties received will be between $800,000 and $900,000 this year. It is worthy of note that during the debate on this bill, a notice was served that a new occupational tax bill would be introduced calling for a 10 per cent tax, although this law is now before the Supreme Court to test its constitutionality. A resolution was passed asking the Governor to call an extra session of the Legislature should the Supreme Court declare the occupational tax law unconstitutional.

New Plant at Hibbing

A permanent crushing and screening plant is to be erected to serve the Hull-Rust open pit of the Oliver Iron Mining Co. at Hibbing. The plant will be similar to the one being erected at the Minnewas property at Virginia. The new plant will contain two 60-in. Allis-Chalmers jaw crushers, which will be fed by stationary bar grizzlies.

MICHIGAN

No Accumulation of Copper at Smelters

Copper shipments out of the Michigan district continue at the rate of approximately 500,000 lb. daily, by rail. The bulk of this copper is for domestic use, less than 30 per cent being purchased for export. The opening of navigation on the Great Lakes, now near at hand, will bring lower freight rates on copper shipments. The rail rate has been reduced, but the rate by water will be even less. There is no accumulation of metal at the Lake smelters, all producers having shipped copper throughout the winter, moving the metal as fast as it was produced.

Efficient Power Unit at Quincy Mine

A new 2,000 kw. turbine has gone into operation at the stamp mill of the Quincy Mining Co., in the Michigan district, and is working smoothly, no adjustments being necessary. It is pronounced one of the most efficient installations of the kind in the district. Exhaust steam from the stamp heads is used to generate 1,500 kw., the remainder of the load of 500 kw. being produced by live steam. Power for the mill and lighting for the mill plant and location are provided, and a considerable saving in costs will result.

THE MARKET REPORT

Daily Prices of Metals

Apr.	Copper, N. Y. net refinery*	Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N. Y.	St. L.	St. L.
26	16.40	43.25	44.25	7.75@8.00	7.75	6.75@6.85
27	16.25@16.35	43.75	44.75	7.65@8.00	7.75	6.70@6.80
28	16.25	43.75	44.75	7.60@7.75	7.50@7.60	6.70@6.80
30	16.25	43.875	44.75	7.60@7.75	7.50	6.65@6.75
May 1	16.25	44.375	45.25	7.55@7.75	7.475@7.50	6.70@6.80
2	16.125@16.25	44.75	45.625	7.55@7.75	7.475@7.50	6.75@6.80
Av.	16.273	43.958	44.896	7.725	7.588	6.754

*These prices correspond to the following quotations for copper delivered: April 26th, 16.65c.; 27th, 16.50@16.60c.; 28th, 30th, and May 1st, 16.50c.; 2d, 16.375@16.50c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. The quotations are for prompt deliveries. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

The quotations are arrived at by a committee consisting of the market editors of *Engineering and Mining Journal-Press* and special representative of the Bureau of Mines and the Bureau of Foreign and Domestic Commerce.

London

April	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
26	72	72⅞	80¼	209½	209½	25½	25¾	32½	32¾
27	71¼	72	80	211	211	25⅜	25⅝	31⅞	32⅛
30	70½	71⅜	79½	210¾	210¾	25¾	26	32¼	32½
May 1	69¾	70½	79¼	213	213	25⅜	25¾	32⅛	32½
2	69¾	70⅝	79¼	215	215	25¾	25¾	31⅞	32⅜

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver and Sterling Exchange

Apr.	Sterling Exchange "Checks"	Silver			Apr.	Sterling Exchange "Checks"	Silver		
		New York Domestic Origin	New York Foreign Origin	London			New York Domestic Origin	New York Foreign Origin	London
26	4.63	99⅝	67	32½	30	4 63⅜	99⅝	68⅜	33 3/16
27	4.63	99⅝	67¼	32⅝	May 1	4.63⅝	99⅝	67¾	32 13/16
28	4.63	99⅝	67¾	32 15/16	2	4.63¾	99⅝	67¾	32¼

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-quarter of a cent premium.

Average Metal Prices for April

Copper:	
New York Electrolytic	16.663
London Standard	73.169
London Electrolytic	81.331
Lead:	
New York	8.101
St. Louis	7.996
London	26.956
Silver:	
New York, foreign	66.855
New York, domestic	99.855
London	32.346
Sterling Exchange	465.220
Zinc:	
St. Louis	7.197
London	34.275
Tin:	
99 per cent	44.280
Straits	45.810
London	213.081
Antimony	8.380
Quicksilver	69.200
Platinum	116.840

Metal Markets

New York, May 2, 1923

There has been more pressure to sell copper and lead during the last week, and as a consequence sales have been slightly better, but at a sacrifice of price. The general antipathy of consumers continues, and prices are in general dependent upon the foreign market.

Copper

Most of the business for the week has been done by the smaller producers, and by second-hands. The larger producers have generally reduced their prices to 16⅝@16¾c. delivered, but these prices are not sufficiently low to attract much business, and in the last two or three days there has been no difficulty in finding sellers at 16.50c. Some quotations as low as 16.25c., delivered, are heard, but the copper offered is undesirable for one reason or another. There has been considerable pressure to sell the ingots at Norfolk recently sold by the Navy Department.

Export demand continues extremely quiet.

Lead

The official contract price of lead set by the American Smelting & Refining Co. was reduced from 8 to 7.75c., New York, on Saturday, April 28, following sales of imported lead at that price, and a pronounced disinclination of consumers to pay more. Since then, Mexican and European lead has been offered at 7.60@7⅝c., without causing a stampede of buyers, and one sale of a good tonnage was sold yesterday for early June delivery as low as 7.55c.

The St. Louis price has declined to 7.50c., which can be done in several directions, and 7.475c. has been named for important tonnages. Consumers are asking that May lead be shipped at the earliest possible date. Inquiries have been quite numerous since Friday. In the last day or two, desilverized has been quoted at 7.525@7.575c., Chicago.

Zinc

Galvanizers are showing a little more interest, though the buying has not been sufficient to affect the market. Prompt continues scarce, and is quoted today at 6.80@6.85c., with discounts of about 5 points for each month forward. May and June have been the favorite deliveries. Prime Western in New York is quoted at the customary freight differential of 35c. per 100 lb. premium, and high-grade is selling for 8.50@9c., delivered.

Tin

In the last day or two consumers have been buying more than for some time, and the decline in price seems to have been checked for the time being. Forward deliveries command about one-half cent premium.

Arrivals of tin, in long tons: Total for April, 6,285. May 1, Straits, 1,265; China, 25; Liverpool, 25.

Gold

Gold in London: April 26th, 88s. 10d.; 27th, 89s. 1d.; 30th, 89s.; May 1st, 88s. 10d.; 2d, 88s. 9d.

Foreign Exchange

On Tuesday, May 1, cable quotations on francs were 6.75c.; lire, 4.89c.; marks, 0.0032½c.; and Canadian dollars 1⅛ per cent discount.

Silver

A new high level for the year was reached in London on April 30. The strength of silver has been due to continued buying by the Orient, which strength may in turn be the result of improved conditions in the liquidation of Far Eastern warehouse supplies.

Mexican Dollars—April 26th, 51⅛; 27th, 51⅛; 28th, 51¼; 30th, 52¼; May 1st, 51¼; 2d, 51¼.

Other Metals

Quotations cover large wholesale lots, f.o.b. New York, unless otherwise specified.

Aluminum—General market for 99 per cent grade, 27c. per lb.; 98 per cent, 26c. London quotations £110.

Antimony — Chinese and Japanese brands, 7.75c. W. C. C., 8½c. Cookson's "C" grade, spot, 10@10½c. Chinese needle antimony, lump, nominal, 6c. per lb. Standard powdered needle antimony (200 mesh), 6½@7c. per lb. White antimony oxide, Chinese, guaranteed 99 per cent Sb_2O_3, 8½@9c.

Bismuth—$2.55 per lb. London, 10s.

Cadmium—$1@$1.10 per lb. London quotes 5s.

Cobalt—Metal, $2.65@$2.85 per lb.; black oxide, $2 per lb. in bbls. London 11 to 12s. for metal; black oxide, 9s.

Iridium—$260@$275 per oz.

Magnesium—Sticks, 1⅛ in., 99.9 per cent, $1.35 per lb. London quotes 4s.@ 4s. 9d. for 99 per cent.

Molybdenum Metal—In rod or wire form, 99.9 per cent pure, $32@$40 per lb., according to gage. Metal powder, 96@98 per cent, $4.50 per lb.

Monel Metal — Shot, 32c.; blocks, 32c. per lb., f.o.b. Bayonne, N. J.

Nickel—28@30c. per lb. for 99 per cent virgin metal.

Osmium—Pure, $75@$80 per oz. troy, in Los Angeles.

Palladium — $81 per oz. London, £17, nominal.

Platinum—$116 per oz. London, £24.

Quicksilver — $68 per 75-lb flask. San Francisco wires $68. London, £10.

Radium—$70 per mg. radium content.

[1]**Rhodium**—$4.50@$5 per gram.

Selenium — Black powdered, amorphous, 99.5 per cent pure, $2.10 per lb.

[1]**Tellurium**—$3 per lb. in 10-lb. lots.

[1]**Thallium Metal**—Ingot, 99 per cent pure, $4 per lb. in 25-lb. lots.

Tungsten Metal—Powder, 97 to 98 per cent, $1 per lb. contained tungsten.

Metallic Ores

Chrome Ore—Indian chrome ore, $20.50 per ton, c.i.f. Atlantic ports. Rhodesian $20@$22 and New Caledonian, $24@$26.

Iron Ore—Lake Superior ores, per long ton, Lower Lake ports: Old Range bessemer, 55 per cent iron, $6.45; Mesabi bessemer, 55 per cent iron, $6.20; Old Range non-bessemer, 51½ per cent iron, $5.70; Mesabi non-bessemer, 51½ per cent iron, $5.55.

Magnetite Ore—F.o.b. Port Henry, N. Y.: Old bed 21 furnace, $5 per long ton; old bed concentrates, 63 per cent, $5.25; Harmony, cobbed, 63 per cent, $5.25; new bed low phosphorus, 65 per cent, $7.50.

Manganese Ore—40@45c. per long ton unit, seaport, plus duty; chemical ore, $75@$80 per gross ton.

Molybdenum Ore—75@85c. per lb. of MoS_2 for 85 per cent MoS_2 concentrates, plus duty.

Tantalum Ore—Hand-sorted ore, 70 per cent combined columbite-tantalite, 40c. per lb., South Dakota.

[1]**Titanium Ores**—Ilmenite, 52 per cent TiO_2, ¾@1c. per lb. for ore. Rutile, 96 per cent TiO_2, 10c. per lb. for ore, with concessions on large lots or contracts.

Tungsten Ore — Wolframite, $8.25; scheelite, $8.50@$9 per unit of WO_3.

Uranium Ore (Carnotite)—Ore containing from 2 to 2½ per cent U_3O_8, $3.50 per lb. of contained U_3O_8.

Vanadium Ore—No quotation. Recently $1 per lb. of V_2O_5 content.

Zircon—$50 per ton.

Zinc and Lead Ore Markets

Joplin, Mo., April 28—Zinc blende, per ton, high, $49.60; basis 60 per cent zinc, premium, $41.50; Prime Western, $40.50@$40; fines and slimes, $39@$37; average settling price, $45.08. Calamine, basis 40 per cent zinc, $26; average $27.70.

Lead, high, $119.60; basis 80 per cent lead, $105; average settling price, $114.85 per ton.

The high average settling price of both zinc and lead above the basis price offerings of the week is the result of prices declining faster than the buyers can ship out advance purchases. All basis prices noted above are made today for future ore delivery.

Shipments for the week: Blende, 16,687; calamine, 122; lead, 1,631 tons. Value, all ores the week, $942,890.

Shipments for four months: Blende, 252,699; calamine, 1,992; lead, 30,773 tons. Value, all ores four months, $14,702,310.

Platteville, Wis., April 28—Blende, basis 60 per cent zinc, $43 per ton. Lead, basis 80 per cent lead, $105 per ton. Shipments for the week: Blende, 1,659 tons; lead, none. Shipments for the year: Blende, 11,237; lead 220 tons. Shipments for the week to separating plants, 2,614 tons blende.

Non-Metallic Minerals

Asbestos.—Crude No. 1, $500; No. 2, $250@$325; long spinning fibers, $135@ $200; magnesia and compressed sheet fiber, $100@$150; shingle stock, $65@ $85; paper stock, $35@$42; cement stock, $20@$25; shorts, $9@$14—all per short ton, f.o.b. mines, Quebec, Canada.

Rhodesian No. 1 crude, $375; No. 2, $250; inferior grade, $200—all c.i.f. Atlantic ports per short ton.

Barytes — Crude, $8@$10 per ton; white, dry ground, $16@$18; white, wet ground, $22@$25 per ton; off color, dry ground, $13@$15; off color, wet ground, $15@$16, f.o.b. plant.

Bauxite—American, crushed and dried, $6@$9 per gross ton; pulverized and dried, $12@$14 per gross ton; calcined, $22@$25 per gross ton, all f.o.b. shipping points. Foreign bauxite offered at $5@$8 per metric ton, c.i.f. Atlantic ports, depending upon grade.

Borax—Granulated and refined, crystals or powdered, in bags, carloads, 5½c. per lb.; in bbls., 5½c. Boric acid, 11c.

Chalk—English, extra light, 5c. Domestic light, 4½@4½c.; heavy, 3½@3½c. per lb., all f.o.b. New York.

China Clay (Kaolin)—Crude, $7@ $9; washed, $8@$9; powdered, $13@ $20, f.o.b. Virginia points. Powdered clay, $14@$20, f.o.b. Virginia points. Imported lump, $15@$20, f.o.b. American ports; powdered, $45@$50, f.o.b., New York, 1A grade, refined, $15@$16 per ton, Delaware.

Canadian, in lumps, $16@$18, f.o.b. Quebec points. Demand good.

Diatomaceous Earth — Crude, air-dried material, in large lumps, $8 per ton, f.o.b. California quarries. Ground material for insulation is priced according to density. It is being sold for $35 per ton, having a settled weight of 15 lb. per cu.ft., and $25 per ton for 20 lb. per cu.ft. The highest grade of material, the so-called "air float" or "bag-house," suitable for polishes and similar uses, brings from $75 to $100 a ton. All prices f.o.b. quarry. Contracts with large consumers are at present in force at a figure as low as $17 per ton, f.o.b. quarries, for filter material. All above quotations are on a minimum car basis, a minimum car holding 20 tons of 2,000 lb.

Emery—Turkish and Greek, 6@8c. per lb. American, 3½@5½c. Inferior grades, 3½c., f.o.b. New England points.

Feldspar — No. 1 pottery grade, $6@$7.50 per long ton; No. 2, $4@ $5.50; f.o.b. North Carolina points. No. 1, $7; No. 2, $6.50; ground, 60 to 80 mesh, $18@$20 per short ton; 120 to 150 mesh, $20@$24; 200 mesh, $25@$30, f.o.b. Connecticut points. No. 1, Canadian, 120 mesh, $20 per net tons, f.o.b. Ohio mills. No. 1 crude, $6 per ton, f.o.b. Maine mines. $8 per ton, New York.

First quality ground, $19 in New Hampshire, $19 in Maine; second quality, $16 in New Hampshire. In Colorado, No. 1 crude, $5; No. 2, $4.50 per short ton.

Fluorspar — Fluxing gravel, 85 per cent CaF_2 and not over 5 per cent silica, $21.50, f.o.b. mines; not over 6 per cent silica, $21; 80 per cent grade, not over 5 per cent silica, $20; ground

[1]Price furnished by Foote Mineral Co., Philadelphia, Pa.

acid grade, $45 in bulk; ground enameling grade, $35 in bulk; packages, $4 extra, all f.o.b. mines, Illinois.

Gravel with limestone gangue, $14; lump, 92 per cent CaF_2, $17, f.o.b. New Mexico.

No. 2, lump, $30; acid lump, $35, f.o.b. Illinois mines.

Enameling grades, uncrushed, $19 per ton, f.o.b. New York. Acid grades, 98½ per cent or better, crushed, $27.50 delivered.

Fuller's Earth—16 to 60 mesh, $18 per ton; 16 to 30 mesh, $17; 30 to 60 mesh, $18; 60 to 100 mesh, $14; 100 mesh and finer, $7.50; f.o.b. Florida mines.

Graphite—American flake, 4@5c. per lb. at mines. Ceylon lump, first quality, 6½c. per lb.; chip 5½c.; dust, 4@4½c. Mexican crude amorphous, $15@$35 per ton, f.o.b. New York. Flake graphite, 10@30c. per lb.; foundry grades, 4@7c.; boiler, 8@14c.; lubricating, 10@50c. per lb.

Gypsum—Crushed rock, $3 per ton in most states. Ground, $3.50@$4, f.o.b. shipping points.

Kaolin—See China Clay.

Limestone—Crushed, New York State shipping points, ¾ in. and larger, $1.10 @$1.35 per net ton. Agricultural limestone, $2.50@$3 per net ton, f.o.b. eastern shipping points.

Magnesite — Dead-burned magnesite grains, $40 per net ton, f.o.b. Baltimore; $40@$42, Chester, Pa.

Crude, $12.50 per ton; 85 to 90 per cent MgO calcined lump, $32.50@$35 per ton; calcined ground, in paper sacks, 90 per cent through 200 mesh, $40@$45 per ton—all f.o.b. California points.

Grecian caustic-calcined and ground, $51@$52 per ton, f.o.b. cars, Atlantic seaboard.

Dead-burned magnesite in bulk, $32 @$34 per net ton, Washington points.

Manjak—Barbados, in 1 to 5 ton lots, grade "C" lump, $330 per short ton; "C" fine, $250; grade "A," $185—all c.i.f. New York.

Mica—Domestic, No. 1 quality, 1½x2 in., 15c. per lb.; 2x2 in., 35c.; 2x3 in., 80c.; 3x3 in., $1.20; 3x4 in., $1.60; 3x5 in., $2; 4x6 in., $2.80; 6x6 in., $3.60, all per lb., f.o.b. North Carolina, thumb trimmed; 1¾ in. disks, 75c. per lb. No. 2 stove mica: punch, 8c.; 2x2 in., 25c.; 2x3 in., 50c.; 3x3 in., $1; 3x4 in., $1.40; 3x5 in., $1.75; 4x6 in., $2.25; 6x8 in., $3.25. Flake, 12c. per lb. Scrap, $25 per ton. All f.o.b. Virginia points.

Scrap, $22 per short ton; washer, 8@10c. per lb.; disk, 15c. per lb., f.o.b. Connecticut points. Market active.

[1]Monazite—Minimum 6 per cent ThO_2, 6@8c. per lb.

Phosphate — 77 to 76 per cent tricalcium phosphate, hard rock, $7.50 per ton, f.o.b. Jacksonville; 77 to 76 per cent pebble grades, $6.75; 75 to 74 per cent pebble, $5.75; 70 per cent pebble, $4.35; 66 to 68 per cent pebble, $3.90, f.o.b. Tampa.

For 72 per cent washed run of mine, $5.50@$6; 75 per cent washed lump, free of fines, $6.75; 75 per cent hand-mined lump, $6.50, all per long ton, f.o.b. Tennessee points. For 65 per cent grades ground to 95 per cent through 100 mesh price is $6@ $6.50 per short ton; $7@$7.50 per short ton for 70 per cent material.

Pumice Stone—Imported lump, 3@ 40c. per lb.; domestic lump, 5c.; ground, 5@6c., all f.o.b. New York.

Pyrites—Imported lump, 1 in. diameter and up, 12c. per unit; furnace size, 2½ in. diameter, 12½c. per unit; fines, through ½-in. mesh, 12c. per unit; cinder property of buyer, ex ship, Atlantic ports. Ore contains 50@51 per cent sulphur; cinder about 63 per cent iron.

Silica—Glass sand, generally $2@ $2.75 per ton, f.o.b. shipping point; sand-blast material, $2.50@$5. Ground, 250 to 450 mesh, $20@$31, f.o.b. mills. Glass sand, $5@$10, f.o.b. Massachusetts.

Sulphur—$16@$18 per ton for domestic, f.o.b. Texas and Louisiana mines; $18@$20 for export, f.a.s. New York.

Talc—160 mesh, dark color, $6; average color, $6.50@$7.50 per ton; 180 mesh, $8; 200 mesh, $8.50 per ton. Price depends upon color as well as fineness. Paper bags, $1 per ton extra. Burlap bags, 12 to the ton, 10c. each extra, with 9c. return allowance.

In New York, 200 to 325 mesh, $14.75 per ton for air-floated talc. 300 mesh, $11.50@$14.75 per ton.

In Georgia, white, $7@$9; yellow, $8.50; red, $12.

In California, 200 mesh, $15@$20 per ton; 300 mesh, $25@$30.

Roofing talc and soapstone, $7@$8 per ton. Paper grades, $10@$18 per ton, f.o.b. mill in Vermont.

Tripoli—Once ground, rose and cream colored, $16@$25; white, $18@$27; double ground, r. and c., $17@$25; w., $19@$30; air-float, r. and c., $25@$30; w., $35; super air-float, r. and c., $35@ $40; w., $40@$45. All per short ton in 200-lb. burlap bags with paper liners, minimum car, 30 tons, f.o.b. Missouri.

Mineral Products

Arsenious Oxide (white arsenic)— Prompt, 15c., nominal. June, 14½c. Second half 1923, 11c. per lb.

Copper Sulphate — Large crystals, 6.20c. per lb.; small 6.10c. Quiet.

Sodium Nitrate—$2.65 per 100 lb., ex vessel Atlantic ports.

Potassium Sulphate — Powder, domestic, $1 per unit, basis 90 per cent.

Sodium Sulphate—$26@$28 per ton, New York.

Ferro-Alloys

Ferrocerium—Per lb., $15@$20.

Ferrochrome—1 to 2 per cent carbon, 28@30c. per lb.; 4 to 6 per cent carbon, 12c. per lb.

Ferromanganese — Domestic, 78@82 per cent, $120 per gross ton, f.o.b., furnace. Spiegeleisen, 19@21 per cent, $40, f.o.b. furnace; 16@19 per cent, $39.

Ferromolybdenum—$2@$2.50 per lb. of contained molybdenum for 50 to 55 per cent grades.

[1]Price furnished by Foote Mineral Co., Philadelphia, Pa.

Ferrosilicon—10 to 12 per cent, $48 @$55 per gross ton, f.o.b. works; 50 per cent, $95 delivered.

Ferrotitanium—For 15 to 18 per cent material, $200@$225 per ton, f.o.b. Niagara Falls, N. Y.

Ferrotungsten — 90@95c. per lb. of contained W., f.o.b. works. Market firm.

Ferro-uranium—35 to 50 per cent U, $6 per lb. of U contained, f.o.b. works.

Ferrovanadium—$3.50@$3.75 per lb. of V contained, f.o.b. works.

Metal Products

Copper Sheets—New York base, 25½c. per lb.; wire, 19¾c. net.

Lead Sheets—Full lead sheets, 10.25c. per lb.; cut lead sheets, 10.50c. in quantity, mill lots.

Nickel Silver—31c. per lb., for 18 per cent nickel Grade "A" sheets.

Yellow Metal — Dimension sheets, 22¾c. per lb.; rods, 19¾c. per lb.

Zinc Sheets—$9.65 per 100 lb., f.o.b. works.

Refractories

Bauxite Brick—$140@$145 per M., Pittsburgh, Pa.

Chrome Brick—$50@$52 per net ton, f.o.b. shipping point.

Chrome Cement — $23 per net ton, f.o.b. shipping point.

Firebrick—First quality, $45@$47 per M., Ohio and Kentucky works; second quality, $41@$43.

Magnesite Brick — 9-in., straights $65@$68 per net ton, f.o.b. works.

Magnesite Cement—$47@$50 per net ton, f.o.b. Chester, Pa.

Silica Brick $47@$49 per M., Pennsylvania; $52@$54, Indiana; $48@$50, Alabama.

[1]Zirkite—Powdered, $50@$60 per ton; brick, $100 per ton.

The Iron Trade

Pittsburgh, May 1, 1923

Production of steel continues at the rate of about 46,000,000 gross tons of ingots a year. Pig-iron production has been above all past records for a month. On April 26 the American Sheet & Tin Plate Co. opened order books for third quarter at the following prices: Blue annealed sheets, 3.00c.; black, 3.85c.; galvanized, 5.00c.; automobile sheets, 5.35c.; tin plate, $5.50.

Finished steel prices for forward delivery now average about 75 per cent above the 1913 average and 45 to 50 per cent above the level at the low point early in March, 1922.

Pig Iron — The market continues quiet, with little prompt business and only occasional inquiry for third quarter. Some producers predict further advances, but the majority of consumers seem to expect the next change to be a decline. The market for six weeks past has stood at $31, Valley, for bessemer, basic, foundry, and malleable.

Connellsville Coke — Spot: Furnace, $6@$6.50; foundry, $7@$7.50.

METAL STATISTICS

Monthly Average Prices of Metals

Silver

	New York		London		Sterling Exchange	
	1922	1923	1922	1923	1922	1923
January	65.450	65.668	35.035	31.928	421.750	465.053
February	65.290	64.313	33.891	30.875	435.511	468.631
March	64.440	67.556	33.269	32.310	436.912	469.269
April	66.575	66.855	34.080	32.346	440.715	465.220
May	71.154		36.023		444.106	
June	71.149		35.900		444.615	
July	70.245		35.644		444.165	
August	69.417		34.957		446.069	
September	69.515		35.305		442.800	
October	68.015		34.498		443.583	
November	65.177		32.882		447.484	
December	63.905		31.383		460.440	
Year	67.528		34.406		442.346	

New York quotations cents per ounce troy, 999 fine, foreign silver. London, pence per ounce, sterling silver, 925 fine.

Copper

	New York		London			
	Electrolytic		Standard		Electrolytic	
	1922	1923	1922	1923	1922	1923
January	13.465	14.510	65.226	64.494	72.321	71.409
February	12.864	15.355	60.250	67.700	66.125	74.500
March	12.567	16.832	59.245	73.851	65.739	81.464
April	12.573	16.663	58.799	73.169	64.028	81.331
May	13.111		61.092		66.554	
June	13.575		61.988		69.333	
July	13.654		63.137		70.321	
August	13.723		63.784		69.932	
September	13.748		63.113		70.917	
October	13.632		62.773		70.693	
November	13.598		62.795		70.216	
December	14.074		63.267		70.132	
Year	13.382		62.123		68.859	

New York quotations, cents per lb. London, pounds sterling per long ton.

Lead

	New York		St. Louis		London	
	1922	1923	1922	1923	1922	1923
January	4.700	7.633	4.388	7.571	23.667	27.119
February	4.700	8.050	4.396	8.093	20.681	28.519
March	4.720	8.252	4.421	8.254	21.266	28.815
April	5.115	8.101	4.946	7.996	22.993	26.956
May	5.420		5.281		24.462	
June	5.745		5.563		24.685	
July	5.729		5.447		24.869	
August	5.824		5.537		24.580	
September	6.110		5.868		24.131	
October	6.530		6.338		25.551	
November	7.047		6.868		26.199	
December	7.163		6.978		26.079	
Year	5.734		5.503		24.097	

New York and St. Louis quotations, cents per lb. London, pounds sterling per long ton.

Tin

	New York				London	
	99%		Straits			
	1922	1923	1922	1923	1922	1923
January	31.480	37.986	32.100	39.173	163.065	181.852
February	29.835	40.693	30.767	42.011	149.850	190.513
March	28.426	46.569	29.171	48.569	143.152	219.607
April	29.810	44.280	30.605	45.810	149.840	213.081
May	30.149		30.971		150.163	
June	30.707		31.497		152.512	
July	31.025		31.733		156.149	
August	32.134		32.380		160.006	
September	32.075		32.395		160.065	
October	33.935		34.600		170.563	
November	35.911		36.734		179.341	
December	36.480		37.695		178.697	
Year	31.831		32.554		159.450	

New York quotations, cents per lb. London, pounds sterling per long ton.

Zinc

	St. Louis		London	
	1922	1923	1922	1923
January	4.691	6.815	26.321	35.733
February	4.485	7.152	24.213	35.613
March	4.658	7.706	25.467	36.720
April	4.906	7.197	26.576	34.275
May	5.110		27.304	
June	5.346		27.893	
July	5.694		29.042	
August	6.212		31.170	
September	6.548		31.750	
October	6.840		34.528	
November	7.104		38.011	
December	6.999		37.757	
Year	5.716		30.003	

St. Louis quotations, cents per pound. London, pounds sterling, per long ton.

Antimony, Quicksilver and Platinum

	Antimony (a)		Quicksilver (b)		Platinum (c)	
	New York		New York		New York	
	1922	1923	1922	1923	1922	1923
January	4.463	6.884	49.960	72.731	97.260	112.462
February	4.416	7.290	48.295	70.636	89.545	113.273
March	4.319	8.885	50.204	70.808	87.500	110.846
April	4.980	8.380	52.280	69.200	87.500	116.840
May	5.467		54.885		85.529	
June	5.145		55.115		87.212	
July	5.091		55.000		90.180	
August	5.315		57.593		98.370	
September	6.580		67.640		117.280	
October	6.905		72.560		109.440	
November	6.584		71.521		108.000	
December	6.382		72.300		113.600	
Year	5.471		58.946		97.618	

(a) Antimony quotations in cents per lb. for ordinary brands. (b) Quicksilver in dollars per flask. (c) Platinum in dollars per ounce.

Pig Iron, Pittsburgh

	Bessemer		Basic		No. 2 Foundry	
	1922	1923	1922	1923	1922	1923
January	21.55	29.27	20.15	27.35	21.34	28.77
February	21.46	29.79	19.71	28.15	20.88	27.21
March	21.35	32.03	19.96	31.79	20.83	31.77
April	22.50		21.26		22.70	
May	26.36		26.87		25.96	
June	26.96		26.96		25.96	
July	26.77		26.33		25.97	
August	30.44		27.18		30.81	
September	35.27		34.70		36.79	
October	35.27		31.77		33.40	
November	33.52		29.37		30.55	
December	29.87		26.34		27.69	
Year	27.61		25.88		26.91	

In dollars per long ton.

Monthly Crude Copper Production

	1922	1923		
	December	January	February	March
Alaska shipments	7,937,421	4,698,184	7,975,434	4,684,081
Washoe Smelter	15,250,000	16,250,000	15,600,000	20,250,000
Calumet & Arizona	3,582,000	3,738,000	2,998,000	3,506,000
Calumet & Hecla	(c)	(c)	(c)	(c)
Other Lake Superior	(c)	(c)	(c)	(c)
Chino	4,941,272	(c)	(c)	(c)
East Butte	(c)	(c)	(c)	(c)
Inspiration	(c)	(c)	(c)	(c)
Miami	5,336,447	5,679,000	5,059,000	5,310,000
Nevada Cons.	2,832,181	(c)	(c)	(c)
New Cornelia	3,256,547	3,034,000	2,666,557	3,181,928
Old Dominion	2,150,000	2,250,000	2,098,000	2,530,000
Phelps Dodge	6,697,000	7,783,000	7,329,000	8,767,000
Ray	4,670,692	4,670,692	(c)	(c)
Shattuck Arizona	(c)	(c)	(c)	(c)
outhwest Metals Co.	1,075,000	971,180	.....	.....
United Verde	(c)	(c)	(c)	(c)
United Verde Extension	3,026,334	3,083,500	3,220,306	3,621,074
Utah Copper	12,464,365	(c)	(c)	(c)
Others, estimated	10,000,000	10,500,000	11,500,000	12,500,000
Total United States	.....	.....	.....	.....
Imports: Ore and concentrates, matte	9,990,310	.....	.....	.....
Imports of black and blister, unrefined	42,290,296	.....	.....	.....
Imports of refined and old	8,791,472	.....	.....	.....
Grand total	.....	.....	.....	.....
Backus & Johnston	(c)	(c)	(c)	(c)
Boleo	1,389,150	1,280,554	.....	1,302,053
Cananea	(c)	(c)	(c)	(c)
Cerro de Pasco	(c)	(c)	(c)	(c)
Chile	(c)	(c)	(c)	(c)
Cons. M. & S. of Canada	(a)	(a)	(a)	(a)
Falcon Mines	578,000	582,000	567,200	.....
Furukawa	3,047,537	.....	.....	.....
Granby Cons.	3,266,200	3,586,661	3,589,377	3,251,360
Hampden Cloncurry	.....	.....	.....	.....
Katanga	10,050,370	9,223,515	7,829,955	8,824,410
Mount Morgan	.....	490,000	832,000	.....
Mount Lyell	586,000	1,352,000	1,012,000	.....
Phelps Dodge Mexican	2,558,000	2,850,000	3,118,000	3,960,000
Sumitomo	.....	.....	1,377,643	.....
Wallaroo & Moonta	486,343	354,372	357,626	.....

Comparative Annual Copper Production

	1920	1921	1922	1923
January	121,903,744	90,596,597	32,010,292	112,341,000
February	117,540,000	86,682,941	45,957,530	102,641,000
March	120,309,316	91 046,345	55,705,760	122,190,000
April	116,078,871	46,946,523 (b)	76,601,000	.....
May	114,964,207	25,310,511 (b)	88,714,000	.....
June	116,107,856	24,623,693 (b)	93,740,000	.....
July	109,729,610	22,033,739 (b)	91,000,000	.....
August	112,460,254	23,248,398 (b)	101,188,000	.....
September	104,919,562	23,855,316 (b)	96,408,000	.....
October	105,231,571	23,231,572 (b)	103,273,000	.....
November	106,700,178	28,341,442	102,845,000	.....
December	95,709,009	29,629,137	103,C03,000	.....

(a) No copper produced during this month. (b) Department of Commerce. (c) Not available.

Freight Rates on Metals, Ores, and Concentrates

In Carload Lots

Freight Rates on Copper Bullion and Refined Copper

From	To	Rate per 2,000 lb. All Rail	Ton of Via Gulf
El Paso, Tex.	Baltimore, Md.	$13.40	.....
Garfield, Utah	Perth Amboy, N. J.	16.50	.....
Garfield, Utah	San Francisco	5.85	.....
Hayden, Ariz.	Perth Amboy, N. J.	16.50	$14.50
Miami, Ariz.	Perth Amboy, N. J.	16.50	14.50
Anaconda, Mont.	Perth Amboy, N. J.	16.50	.....
Butte, Mont.	Perth Amboy, N. J.	16.50	.....
Humboldt, Ariz.	Chrome, N. J.	16.50	14.50
Douglas, Ariz.	Perth Amboy, N. J.	16.50	14.50
Globe, Ariz.	Perth Amboy, N. J.	16.50	14.50
Clifton, Ariz.	Perth Amboy, N. J.	16.50	14.50
Clarkdale, Ariz.	Chrome, N. J.	16.50	14.50
Copperhill, Tenn.	Laurel Hill, N. Y.	10.80	.....
Tooele, Utah	Chrome, N. J.	16.50	.....
McGill, Nev.	Baltimore, Md.	15.90	.....
Houghton, Mich.	New York	(a) 9.60	.....
Hancock, Mich.	New York	(a) 9.60	.....
Hubbell, Mich.	New York	(a) 9.60	.....
Dollar Bay, Mich.	New York	(a) 9.60	.....
Tacoma, Wash.	New York (water)	Around $4.00	
Anaconda, Mont.	Tacoma, Wash.	7.09	.....
Ajo, Ariz.	New York	16.50	14.50

(a) Applies April 1 to Nov. 30 of each year.

Lead Bullion; Also Pig Lead Where Shown

From	Rates per Ton of 2,000 Lb. To New York	To St. Louis
East St. Louis, Ill.	$7.00	.....
Pueblo, Colo.	14.15	$9.65
Leadville, Colo.	16.50	11.40
East Helena, Mont.	16.50	11.40
El Paso, Tex. (domestic)	(c) 12.00 Via Gulf (c) 14.00 All Rail	(b) 7.76½
Omaha, Neb.	9.60	3.65
Murray, Utah	16.50	11.40
Midvale, Utah	16.50	11.40
Tooele, Utah	16.50	11.40
East Chicago, Ill.	6.40	(a) 2.00
Kellogg, Idaho	16.50	11.40
Carnegie, Pa.	3.80	(a) 5.00
Selby, Calif.	Around $4.50 via Canal	.....
Herculaneum, Mo.	(a) 8.80	(a) 1.80
Federal, Ill.	7.00	(a) 1.80
Collinsville, Ill.	7.00	(a) .75½
Granby, Mo.	(a) 10.50	(a) 3.50
Joplin, Mo.	(a) 10.50	(a) 3.50

(a) Pig lead only.
(b) Pig lead only when originating in Mexico.
(c) Shipments of bullion originating in Mexico, $2 per ton less.

Zinc

From	Rates per Net Ton To East St. Louis	To New York
Donora, Pa.	(a) $4.60	$3.80
Langeloth, Pa.	(a) 4.60	3.80
Palmerton, Pa.	7.50	3.00
Hillsboro, Ill.	1.40	7.00
Danville, Ill.	2.00	6.40
La Salle, Ill.	2.00	6.70
Springfield, Ill.	3.00	7.00
Cleveland, Ohio	5.80	6.40
Moundsville, W. Va.	4.40	3.80
Van Buren, Ark.	3.80	10.80
Fort Smith, Ark.	3.80	10.80
Bartlesville, Okla.	3.50	10.50
Blackwell, Okla.	3.80	10.80
Henryetta, Okla.	3.80	10.80
Sand Springs, Okla.	3.80	10.80
Cherryvale, Kan.	3.50	10.50
Black Eagle, Mont.	9.40	14.50
Park City, Utah	11.40	16.50

(a) To St. Louis, Mo.

Zinc Ores and Concentrates to Oklahoma Smelters

Commodity	To	From	Rate per Net Ton
Zinc ore and concentrates, carloads	Bartlesville, Okla.	Altoona, Kan.	$2.10
		Pittsburg, Kan.	1.80
		Galena, Kan.	1.30
		Joplin, Mo.	1.40
		Iola, Kan.	1.80
		Baxter, Kan.	1.40
		Miami, Okla.	1.40
		Quapaw, Okla.	1.40
		Kansas City, Mo.	1.60
Zinc ore and concentrates, carloads	Sand Springs, Okla.	Miami, Okla.	2.20
		Quapaw, Okla.	2.20
		Galena, Kan.	1.50
		Joplin, Mo.	1.50
		Iola, Kan.	2.40
Zinc ore and concentrates, carloads	Dewar, Okla. Kusa, Okla. Henryetta, Okla.	Cave Springs, Mo.	2.00
		Cent City Spur, Mo.	2.00
		Chitwood, Mo.	2.00
		Galena, Kan.	1.50
		Iola, Kan.	2.40
		La Harpe, Kan.	2.40
Zinc ore and concentrates, carloads	La Harpe, Kan.	Mound City, Kan.	.50
		Oswego, Kan.	.50
		Parsons, Kan.	.50
Zinc ore and concentrates, carloads	Coffeyville, Kan.	Galena, Kan.	1.10
		Joplin, Mo.	1.30
Lead ore and concentrates, carloads	Bartlesville, Okla.	Baxter, Kan.	1.80
		Miami, Okla.	1.80
		Quapaw, Okla.	1.80

Rates on Ores and Concentrates

From	To	Value of Product	$5	$10	$15	$20	$25	$30	$35	$40	$50	$60	$70	$75	$80	$90	$100
		Rate															
Butte, Mont.	Anaconda, Mont.		.17	.17	.17	.17	.17	.17	.17	.17	.17	.17	.17	.17	.17	.17	.17
Butte, Mont.	Black Eagle, Mont (a)		1.02	1.62	1.02	1.02	1.02	1.02	1.02	1.02	.....	.....	.....	.....	.....	.....	.....
Great Falls, Mont.	East Helena, Mont.		.....	.....	1.50	.....	.....	.....	1.91	.....	2.36	.....	.....	.....	.....	.....	2.48
Butte, Mont.	East Helena, Mont.		.....	.....	1.17	.....	1.46	.....	1.69	.....	2.03	.....	.....	.....	.....	.....	2.14
Paxton, Calif.	Salt Lake Smelters, Utah (b)		.....	.....	.....	.....	.....	.....	.....	.....	6.30	7.00	7.70	.....	8.40	9.10	9.80
Johannesburg, Calif.	Selby, Calif.		.....	.....	.....	3.40	.....	4.10	.....	4.80	5.50	6.20	6.90	.....	7.60	8.00	8.30
Johannesburg, Calif.	Humboldt, Ariz.		.....	.....	.....	3.40	.....	4.10	.....	4.80	5.50	6.20	6.90	.....	7.60	8.00	8.30
Creede, Colo.	Durango, Colo.		.....	.....	3.25	3.50	3.75	4.00	.....	4.25	4.75	5.25	5.75	6.05	.....	.....	7.10
Ouray, Colo.	Durango, Colo.		.....	.....	4.30	4.80	.....	5.05	.....	.....	5.90	.....	6.30	.....	.....	.....	7.70
Kokomo, Colo.	Durango, Colo.		.....	6.00	.....	.....	6.50	7.20	.....	.....	.....	.....	.....	.....	.....	.....	.....
Telluride, Colo.	Durango, Colo.		.....	.....	.....	.....	.....	4.30	.....	5.00	5.90	6.30	6.30	.....	.....	.....	7.70
Silverton, Colo.	Durango, Colo.		.....	.....	1.40	1.40	.....	.....	2.20	.....	.....	2.30	2.55	.....	2.80	.....	2.80
Tyrone, N. M.	Douglas, Ariz.		.....	.....	1.60	1.90	.....	2.20	.....	2.50	2.80	.....	.....	3.40	.....	.....	3.80
Tyrone, N. M.	El Paso, Tex.		.....	.....	1.60	1.90	.....	2.20	.....	2.50	2.80	.....	.....	3.40	.....	.....	3.80
Lordsburg, N. M.	Douglas, Ariz.		.....	1.00	1.30	1.60	.....	1.90	.....	2.00	2.00	.....	.....	2.80	.....	.....	3.40
Lordsburg, N. M.	El Paso, Tex.		.....	1.00	1.30	1.60	.....	1.90	.....	2.20	2.50	.....	.....	2.80	.....	.....	3.40
Tombstone, Ariz.	Douglas, Ariz.		.....	.....	.60	.....	.90	.....	.....	.....	1.30	.....	.....	1.60	.....	.....	1.90
Tombstone, Ariz.	El Paso, Tex.		.....	.....	1.90	.....	2.50	.....	.....	.....	3.80	.....	.....	4.40	.....	.....	4.40
Silver City, N. M.	Douglas, Ariz.		.....	.....	2.48	.....	3.15	.....	.....	.....	3.83	.....	.....	.....	.....	.....	5.29
Ray Junction, Ariz.	Hayden, Ariz.		.....	.10	.....	.40	.....	.50	.....	.80	.90	.....	.....	1.00	.....	.....	1.10

(a) Minimum tonnage of 500 tons per day. (b) In open cars, minimum 80,000 lb.

Rates on Ore and Concentrates

From	To	Value of Ores and Concentrates	$10	$15	$20	$25	$30	$35	$40	$50	$60	$70	$75	$80	$90	$100
		Rate														
Burke, Idaho	Bradley, Idaho		.....	.....	.....	.....	.....	.....	.....	.....	.68	.....	.....	.....	.....	1.02
Burke and Wallace, Idaho	East Helena, Mont.		.....	.....	.....	.....	3.00	.....	3.25	3.50	3.75	4.00	.....	4.25	4.50	4.75
Sagel, Idaho	East Helena, Mont.		.....	.....	.....	3.38	.....	3.83	.....	4.16	.....	.....	.....	.....	.....	4.84
Arizona Tunnel, Idaho	Bradley, Idaho		.....	.....	.....	.....	.....	.....	.....	.....	.35	.....	.....	.....	.....	.50
Bayview, Idaho	Bradley, Idaho		.....	.....	.....	.....	.....	.....	.....	3.75	.....	.....	4.37½	.....	.....	5.12½
Park City, Utah	Salt Lake Smelters		1.00	1.10	1.25	.....	1.50	.....	1.75	.....	2.00	.....	.....	2.25	.....	2.50
Eureka, Utah	Salt Lake Smelters		1.00	.....	1.25	.....	1.50	.....	1.75	2.00	2.25	2.50	.....	2.75	3.00	3.25
Tintic, Utah	Salt Lake Smelters		1.00	.....	1.25	1.50	1.50	.....	1.75	2.00	2.25	2.50	.....	2.75	3.00	3.25
St. Johns, Utah	Salt Lake Smelters		1.00	.....	1.25	.....	1.50	.....	1.75	2.00	2.25	2.50	.....	2.75	3.00	3.25
Ophir, Utah	Salt Lake Smelters		1.00	.....	1.25	.....	1.50	.....	1.75	2.00	2.25	2.50	.....	2.75	3.00	3.25
Bingham, Utah	Garfield, Utah		.....	.40	.....	.75	.....	.....	.....	.95	.....	.....	1.10	.....	.....	1.25
Cherry Creek, Nev.	Garfield, Utah		.....	.....	4.60	.....	5.10	.....	5.60	6.10	6.60	7.10	.....	7.60	8.10	8.60
Goldfield, Nev.	Salt Lake Smelters		.....	.....	5.10	.....	5.80	.....	6.50	7.20	7.90	8.60	.....	9.30	10.00	10.70
Battle Mountain, Nev. (a)	Salt Lake Smelters		.....	.....	3.20	.....	3.80	.....	4.40	5.00	5.60	6.20	.....	6.80	7.40	8.00
Palisade, Nev. (a)	Salt Lake Smelters		.....	.....	3.20	.....	3.80	.....	4.40	5.00	5.60	6.20	.....	6.80	7.40	8.00
Mina, Nev. (a)	Salt Lake Smelters		.....	.....	3.60	.....	4.30	.....	5.00	5.70	6.40	7.10	.....	7.80	8.50	9.20
Lovelock, Nev. (a)	Salt Lake Smelters		.....	.....	3.20	.....	3.90	.....	4.60	5.30	6.00	6.70	.....	7.40	8.10	8.80
Golconda, Nev. (a)	Salt Lake Smelters		.....	.....	3.20	.....	3.90	.....	4.60	5.30	6.00	6.70	.....	7.40	8.10	8.80
Hazen, Nev. (a)	Salt Lake Smelters		.....	.....	3.20	.....	3.90	.....	4.60	5.30	6.00	6.70	.....	7.40	8.10	8.80
Tonopah, Nev.	Salt Lake Smelters		.....	.....	5.10	.....	5.80	.....	6.50	7.20	7.90	8.60	.....	9.30	10.00	10.70
Rogerson, Idaho	Salt Lake Smelters		3.00	.....	3.50	.....	4.00	.....	4.50	5.00	5.50	6.00	.....	6.50	7.00	7.50

(a) Minimum weight, marked capacity of car used, but not less than 80,000 lb.

COMPANY REPORTS

East Butte Copper Mining Co.

Copper; Butte, Mont.

A report of the operations of the East Butte Copper Mining Co. for 1922 shows a loss of $134,343,121, according to the following operating statement:

Gross value of metals shipped	$2,362,296.05
Other income	36,548.88
Gross income from all operations	2,398,844.93
Total cost of copper delivered New York	$2,506,794.30
Miscellaneous operations	12,480.32
Total cost of operations	2,519,274.62
Loss on mining operations	$120,429.69
Depreciation	1,133.96
Outside exploration	12,779.56
Total deficit all operations	134,343.21
Price per pound received, New York, cents	13.5167
Cost of production per pound delivered New York, cents	14.7306
Loss per pound, cents	1.2139
Price per ounce received for silver, New York, cents	99.6314
Price per ounce received for gold, New York	$20.00

Balance sheet as of Dec. 31, 1922, is given as follows:

Assets

Property		$3,342,515.51
United States Liberty Bonds		300,000.00
Cash and metals		1,054,599.18
Cash	$116,188.91	
Copper in transit and on hand	938,410.27	
Accounts receivable		414,290.33
Equipment and supplies		259,510.14
Deferred charges		7,977.57
		$5,378,892.73

Liabilities

Capital stock		$4,248,870.00
Authorized	$6,000,000.00	
Unissued	1,751,130.00	
Accounts payable		876,361.59
Current	$310,536.37	
Due Pittsmont Copper Co., account rentals	565,825.22	
Contingent funds		126,398.11
Surplus		127,263.03
		$5,378,892.73

Production amounted to 12,347,178 lb. of copper, 542,650 oz. of silver, and 6,567 oz. of gold, from 97,202 tons of company ore and 88,065 tons of custom ore.

Arizona Commercial Mining Co.

Copper; Arizona

A report of the operations of the Arizona Commercial Mining Co. for 1922 shows a loss of $107,395.29 according to the following account:

Income		
Sales of copper, silver and gold		$1,256,779.62
Expenses		
Mining, treating and refining	$1,044,230.91	
Selling, general and administrative	30,185.63	
Expenditure during suspension of operations, and for special litigation	59,976.32	
Depreciation	66,927.69	
Depletion	139,105.00	
Interest	23,749.36	
		1,364,174.91
Loss for the year 1922		$107,395.29

Balance sheet as of Dec. 31, 1922, is given as follows:

Assets

Fixed		
Mining properties, plant and equipment		$4,113,720.91
Current	$168,516.63	
Accounts receivable	438,694.50	
Cash	38,191.15	
		645,402.28
		$4,759,123.19

Liabilities

Capital stock		
Authorized—300,000 shares of $5 each; issued—265,000 shares		$1,325,000.00
Current		
Loans and accounts payable		417,188.24
Reserves		
Depreciation	$291,078.73	
Depletion	828,744.40	
		1,119,823.13
Surplus		
Balance at Dec. 31, 1921	$2,004,507.11	
Loss for the year 1922—per income account	107,395.29	
		1,897,111.82
		$4,759,123.19

Production amounted to 6,220,923 lb. of refined copper, 27,532 oz. of silver, and 1,585 oz. of gold.

Phelps Dodge Corporation

A report of the operations of the Phelps Dodge Corporation for 1922 shows a loss of $5,825,631, according to the following income account:

Income		
Sales of metals, fuel and merchandise	$24,888,046.70	
Income from investments and miscellaneous earnings	260,221.48	
		$25,148,268.18
Expenses		
Cost of metals, fuel, and merchandise	$24,155,062.33	
Depreciation	2,181,346.87	
Depletion	3,902,336.45	
Interest	735,153.96	
		30,973,899.61
Loss for the year 1922		$5,825,631.43

Balance sheet as of Dec. 31, 1922, is given as follows:

Assets

Mines and mining claims	$159,778,363.06	
Plants and miscellaneous properties	35,140,422.56	
		$194,918,785.62
Stripping expenses—chargeable to future operations	$7,107,478.64	
Ores and concentrates	1,722,343.60	
Material and supplies	3,154,185.53	
Expenses prepaid	780,581.57	
Investments	5,150,599.66	
Metals on hand—copper at cost, silver and gold at market	1,643,334.94	
Copper sold Copper Export Association, Inc. (at cost less amount received on account)	1,247,553.66	
Merchandise (P. D. Mercantile Co.)	1,249,601.13	
Accounts receivable	7,785,732.19	
Cash	1,943,431.30	
		$31,784,842.22
		$226,703,627.84

Liabilities

Capital stock — authorized and issued — 500,000 shares at $100,000		$50,000,000.00
316,530 outstanding preference stock of the Arizona Copper Co., Ltd.—to be retired prior to Sept. 30, 1926		1,540,446.00
Accounts payable—including balances due for copper sales, reserves for taxes, etc.	$18,570,668.80	
Dividends payable—Jan. 2, 1923	500,000.00	
		19,070,668.80
Reserve for depletion	$49,539,588.38	
Reserve for depreciation	13,792,877.35	
		63,332,465.73
Surplus—Balance Dec. 31, 1921	$100,585,678.74	
Loss for year 1922, per income account	5,825,631.43	
	$94,760,047.31	
Dividends	2,000,000.00	92,760,047.31
		$226,703,627.84

In 1922, the metals produced from the ores of the branches and subsidiaries of the Phelps Dodge Corporation were 87,806,403 lb. of copper, 8,966,448 lb. of lead, 247,793 lb. of zinc, 1,870,564 oz. of silver, and 17,071 oz. of gold. There were also produced from purchased ores smelted, 1,691,149 lb. of copper, 145,653 oz. of silver, and 1,262 oz. of gold.

Including copper received from other sources, 151,836,758 lb. was sold and delivered to buyers at an average price of 13.34c. per lb., net cash f.o.b. New York:

MINING STOCKS

Week Ended April 28, 1923

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Ahmeek	Boston	80	75	77½	Mar. 23, Q	$1.00
Alaska-Br. Col.	N. Y. Curb	2	1⅞	1⅞	.....	....
Allouez	Boston	27	26	26	Mar. '19	1.00
Anaconda	New York	49	47⅜	48⅛	Apr. '23, Q	0.75
Arcadian Consol.	Boston	2⅜	2⅛	2⅛	.....	....
Ariz. Com'l	Boston	12⅛	12⅛	12⅛	Oct. '18, Q	0.50
Calaveras	N. Y. Curb	3⅜	3⅜	3⅜	.....	....
Calumet & Arizona	Boston	48½	57	58	Mar. '23,	1.00
Calumet & Hecla	Boston	395	350	390	Mar. '23, Q	7.00
Centennial	Boston	11	11	11	Dec. '18, SA	1.00
Cerro de Pasco	New York	46½	45½	45½	Mar. '21, Q	0.50
Chile Copper	New York	28⅛	26⅛	27	Mar. 23,	0.625
Chino	New York	27½	26⅝	26⅝	Sept. '20, Q	0.37
Con. Coppermines	N. Y. Curb	3½	3½	3½	.....	....
Copper Range	Boston	40	38	38⅜	Mar. '22, Q	1.00
Crystal Copper	Boston Curb	1⅜	1 3/16	1⅜	.....	....
Davis-Daly	Boston	3⅜	3	3⅜	Mar. '20, Q	0.25
East Butte	Boston	8½	8	8⅛	Dec. '19, A	0.50
First National	Boston Curb	*57	*45	*55	Feb. '19, SA	0.15
Franklin	Boston	1⅜	1⅛	1⅛	.....	....
Gadsden Copper	N. Y. Curb	*65	*65	*65	.....	....
Granby Consol.	New York	30½	29½	29½	May '19, Q	1.25
Greene-Cananea	New York	27⅜	27⅜	27⅜	Nov. '20, Q	0.50
Hancock	Boston	3½	3	3	.....	....
Howe Sound	N. Y. Curb	3½	3½	3½	Jan. '21, Q	0.05
Inspiration Consol.	New York	38	37⅜	37⅜	Apr. '23, Q	0.50
Iron Cap	Boston Curb	7⅜	7⅜	7⅜	May 1, K	0.15
Isle Royale	Boston	28⅛	27	27	Mar. '23, Q	0.50
Kennecott	New York	40⅜	38⅛	39⅛	Apr. '23, Q	0.75
Keweenaw	Boston	†1⅜	†1⅜	1⅜	.....	....
Lake Copper	Boston	3½	3⅜	3⅜	.....	....
Magma Copper	New York	34⅛	33⅛	33⅛	Jan. '19, Q	0.50
Mason Valley	N. Y. Curb	2⅜	2⅛	2⅛	.....	....
Mass Consolidated	Boston	3	3	3	Nov. '17, Q	1.00
Miami Copper	New York	29⅜	29⅛	29⅛	Apr. '23, Q	0.50
Michigan	Boston	2	1⅜	2	.....	....
Mohawk	Boston	58	54⅛	55	Mar. '23, Q	1.00
Mother Lode Coa.	New York	11	10½	11	Mar. '23, K	0.50
Nevada Consol.	New York	15⅜	14⅜	14⅜	Sept. '20, Q	0.25
New Cornelia	Boston	20	19⅜	19⅜	Feb. '23, Q	0.25
North Butte	Boston	9⅛	9⅛	9⅛	Oct. '18, Q	0.25
Ohio Copper	N. Y. Curb	*86	*75	*79	.....	....
Old Dominion	Boston	27⅛	26⅛	26⅛	Dec. '18, Q	1.00
Osceola	Boston	37⅛	35	37⅛	Mar. '23, K	1.00
Phelps Dodge	Open Mar.	†190	†180	....	Apr. '23, Q	1.00
Quincy	Boston	42	41	42	Mar. '20, Q	1.00
Ray Consolidated	New York	15⅛	14⅜	15	Dec. '20, Q	0.25
Ray Hercules	N. Y. Curb	1 13/16	1⅜	1⅜	.....	....
St. Mary's Min. Ld.	Boston	46⅛	45	45	Mar. '23, K	3.00
Seneca Copper	New York	9⅛	8⅜	8⅜	.....	....
Shannon	Boston	*88	*88	*88	Nov. '17, Q	0.25
Shattuck Arizona	New York	9	8⅛	8⅛	Jan. '20, Q	0.25
South Lake	Boston	†*75	†*45	*50	.....	....
Superior & Boston	Boston	2⅛	2	2	.....	....
Tenn. C. & C. cfs.	New York	11⅛	11	11	Apr. '23, Q	0.25
Tuolumne	Boston	*48	*40	*40	May '13,	0.10
United Verde Ex.	N. Y. Curb	37⅜	37	37⅜	Nov. '22, Q	0.25
Utah Consol.	Boston	2⅛	1⅛	1⅛	Sept. '18,	0.25
Utah Copper	New York	70⅛	68	68	Mar. '23, Q	1.00
Utah Metal & T.	Boston	*96	*90	*97	Dec. '17,	0.30
Victoria	Boston	†1⅛	†1⅛	1⅛	.....	....
Winona	Boston	*96	*75	*96	.....	....
Wolverine	Boston	10	9⅛	10	.....	....
NICKEL-COPPER						
Internat. Nickel	New York	14⅛	14	14⅛	Mar. '19,	0.50
Internat. Nickel, pfd.	New York	77⅛	75⅛	77	Feb. '23, Q	1.50
LEAD						
Carnegie Lead & Zinc	Pittsburgh	5	5	5	.....	....
National Lead	New York	128	126	127	Mar. '23, Q	2.00
National Lead, pfd.	New York	111⅛	111	111	Mar. '23, Q	1.75
St. Joseph Lead	New York	20⅛	20	20⅛	Mar. '23, Q,X	0.50
ZINC						
Am. Z. L. & S.	New York	16⅛	15	16	May '20,	1.00
Am. Z. L. & S. pfd.	New York	52⅛	50⅛	52	Nov. '20, Q	1.50
Butte C. & Z.	New York	8⅛	8⅛	8⅛	Mar. '23,	0.50
Butte & Superior	New York	31⅛	30	30	Mar. '23, Q	0.50
Callahan Zn-Ld	New York	9⅛	8⅛	9	Dec. '20, Q	0.50
New Jersey Zn.	N. Y. Curb	174⅛	172	172⅛	Feb. '23, Q	2.00
United Zinc	N. Y. Curb	1⅛	1	1⅛	.....	....
Yellow Pine	Los Angeles	....	....	*65	Sept. '20, Q	0.03
SILVER						
Alvarado	N. Y. Curb	5⅛	5⅛	5⅛	.....	....
Batopilas Mining	New York	⅜	⅜	⅜	Dec. '07, I	0.12½
Beaver Consol.	Toronto	*45⅛	*44	*44⅛	May '20, K	0.03
Candelaria	N. Y. Curb	*18	*9	*13	.....	....
Castle-Trethewey	Toronto	*28	*26½	*26½	.....	....
Coniagas	Toronto	2.85	2.60	2.65	May '21, Q	0.12½
Crown Reserve	Toronto	*73⅛	*70	*73⅛	Jan. '17,	0.05
Hilltop-Nev.	N. Y. Curb.	1 1/16	1⅛	1 1/16	.....	....
Kerr Lake	N. Y. Curb	3	3	3	Apr. '23, Q	0.12½
La Rose	Toronto	*30	*28½	*28½	Apr. '22,	0.10
McKinley-Dar.-Sav.	Toronto	*22	*20	*20	Oct. '20, Q	0.03
Mining Corp. Can.	Toronto	3.15	3.00	3.04	Sept. '20, Q	0.12½
Nipissing	N. Y. Curb	6⅛	5⅛	5⅛	Apr. '23, Q	0.15
Ontario Silver	New York	6⅛	6	6⅛	Jan. '19, Q	0.50
Temiskaming	Toronto	*50	*46⅛	*48⅛	Jan. '20, K	0.04

Stock	Exch.	High	Low	Last		Last Div.
GOLD						
Alaska Gold	New York	⅛	⅛	⅛	.....	....
Alaska Juneau	New York	1⅛	1⅛	1⅛	.....	....
Carson Hill	Boston	7	6⅞	6⅞	.....	....
Cresson Consol. G.	N. Y. Curb	3⅜	3⅜	3⅜	Apr. '23 Q	0.10
Dome Mines	New York	42⅜	39⅜	40	Apr. '23, Q	0.50
Golden Cycle	Colo. Springs	1.09	1.09	1.09	Dec. '22, Q	0.02
Hollinger Consol.	Toronto	13.50	13.25	13.50	Apr. '23, M	0.05
Homestake Mining	New York	69½	69½	69½	Apr. '23, M	0.50
Kirkland Lake	Toronto	*58	*54	*58	.....	....
Lake Shore	Toronto	3.45	3.40	3.40	Nov. '22, Q	0.02
McIntyre- Porcupine	New York	18⅜	18	18	Apr. '23,	0.25
Portland	Colo. Springs	*32	*32	*32	Oct. '20, Q	0.01
Teck-Hughes	N. Y. Curb	1 1/16	1 1/16	1⅛	.....	....
Tom Reed	Los Angeles	....	....	*95	Dec. '19,	0.02
United Eastern	N. Y. Curb	2	1⅞	2	Apr. '23, Q	0.15
Vipond Cons.	Toronto	*74	*71	*71	.....	..
White Caps Mining	N. Y. Curb	*9	*8	*8	.....	....
Wright-Hargreaves	Toronto	3.57	3.54	3.57	Apr. '23,	0.02½
Yukon Gold	N. Y. Curb	1⅞	1⅞	1⅞	June '18,	0.02½
GOLD AND SILVER						
Boston-Mont. Corp.	N. Y. Curb	*17	*11	*17	.....	....
Cons. Virginia	San Francisco	14⅛	11⅛	11⅛	.....	....
Continental Mines	N. Y. Curb	5	4½	5	.....	....
Dolores Esperanza	N. Y. Curb	1⅞	1⅞	1⅞	Apr. '23	2.50
Tonopah Belmont	N. Y. Curb	1⅛	1 1/16	1 1/16	Apr. '23, Q	0.05
Tonopah Divide	N. Y. Curb	*67	*51	*55	.....	....
Tonopah Extension	N. Y. Curb	2⅜	2 1/16	2⅜	Jan. '23, Q,X	0.10
Tonopah Mining	N. Y. Curb	1⅜	1 1/16	1⅜	Apr. '23, Q	0.7½
Unity Gold	N. Y. Curb	5⅜	4⅞	5⅛	.....	....
West End Consol.	N. Y. Curb	1 1/16	1 1/16	1 1/16	Mar. '23, Q	0.05
SILVER-LEAD						
Bingham Mines	Boston	†18	†17½	18	Sept. 19, Q	0.25
Caledonia Mng.	N. Y. Curb	*6	*6	*6	Jan. '21, M	0.01
Cardiff M. & M.	Salt Lake	*74	*33½	*72	Dec. '20,	0.15
Chief Consol.	Boston Curb	4⅛	4½	4⅛	Feb. '23, Q	0.10
Columbus Rexall	Salt Lake	*57	*40	*55	Aug. '22,	0.03
Consol. M. & S.	Montreal	28½	26¼	26½	Oct. '20, Q	0.62½
Federal M. & S.	New York	....	....	10½	Jan. '09,	1.50
Federal M. & S. pfd.	New York	51	50	50	Mar '23, Q	1.75
Florence Silver	Spokane	*38	*38	*38	Apr. '19, Q,X	0.01½
Hecla Mining	N. Y. Curb	9⅛	9⅛	9⅛	Mar. '23,	0.25
Iron Blossom Con.	N. Y. Curb	*36	*32	*32	Apr. '22, Q	0.02½
Marsh Mines	N. Y. Curb	*15	*13	*15	June '21, I	0.02
Park City	Salt Lake	3.40	3.35	3.40	Apr. '23,	0.12½
Park Utah	N. Y. Curb	....	....	3¾	Apr. '23	0.15
Prince Consol.	Salt Lake	*15	*9½	*11	Nov. '17,	0.02½
Silversmith	Spokane	*43	*40⅝	*40⅛	Apr. 23,	0.01
Simon Silver Lead	N. Y. Curb	*48	*40	*42	.....	....
Tamarack-Custer	Spokane	1.55	1.50	1.55	Jan. '21, K	0.04
Tintic Standard	Salt Lake	2.85	2.80	2.85	Dec. '22, Q,X	0.10
Utah-Apex	Boston	5⅜	5⅛	5⅛	Nov. '20, K	0.25
IRON						
Bethlehem Steel	New York	65⅜	62½	63½	Apr. '23, Q	1.25
Char. Iron	Detroit	2	2	2	.....	....
Char. Iron, pfd.	Detroit	3½	3½	3½	.....	....
Colorado Fuel & Iron	New York	34⅛	29½	33½	May '21	0.75
Col. Fuel & Iron, pfd.	New York	....	....	102	Feb. '23, Q	2.00
Gt. North'n Iron Ore	New York	31⅛	31	31⅛	Dec. '22	1.00
Inland Steel	N. Y. Curb	....	....	46½	Mar. '23	0.25
Mesabi Iron	N. Y. Curb	9⅜	9	9	.....	....
Replogle Steel	New York	25⅜	24	24½	.....	....
Republic I. & S.	New York	63½	60½	61⅛	May '21	1.50
Republic I. S., pfd.	New York	95½	92⅜	95½	Apr. '23	1.75
Sloss-Sheffield S. & I.	New York	60	53½	58	Feb. '21	1.50
Sloss-Shef. S.&I., pfd.	New York	86	83½	86	Apr. '23	1.75
U. S. Steel	New York	106½	104⅛	105	Mar. '23, Q	1.25
U. S. Steel, pfd.	New York	120	119½	119⅜	Feb. '23	1.75
Virginia I. C. & C.	New York	66½	64½	66	Jan. '22	1.50
Virginia I.C.&C., pfd.	New York	85	85	85	Jan '23	2.50
VANADIUM						
Vanadium Corp.	New York	38½	35	37⅛	Jan. '21, Q	1.00
ASBESTOS						
Asbestos Corp.	Montreal	70	68	69⅛	Apr. '23 Q	1.50
Asbestos Corp. pfd.	Montreal	89⅛	89	89	Apr. '23 Q	1.75
SULPHUR						
Freeport Texas	New York	17⅛	16⅜	17	Nov. '19, Q	1.00
Texas Gulf	New York	64	62⅛	62⅛	Mar. '23, Q	1.25
PLATINUM						
So. Am. Gold & P.	N. Y. Curb	3½	3	3	.....	....
MINING, SMELTING AND REFINING						
Amer. Metal	New York	49	47	48	Mar. '23, Q	0.75
Amer. Metal pfd.	New York	....	....	114	Mar. '23, Q	1.75
Amer. Sm. & Ref.	New York	64⅜	62	62⅜	Mar. '21, Q	1.00
Amer. Sm.& Ref. pfd	New York	99⅛	98⅛	99¼	Mar. '23 Q	1.75
U. S. Sm. R. & M.	New York	35	33	35	Jan. '21, Q	0.50
U.S. Sm.R.& M. pfd.	New York	....	....	44½	Apr. '23 Q	0.87½

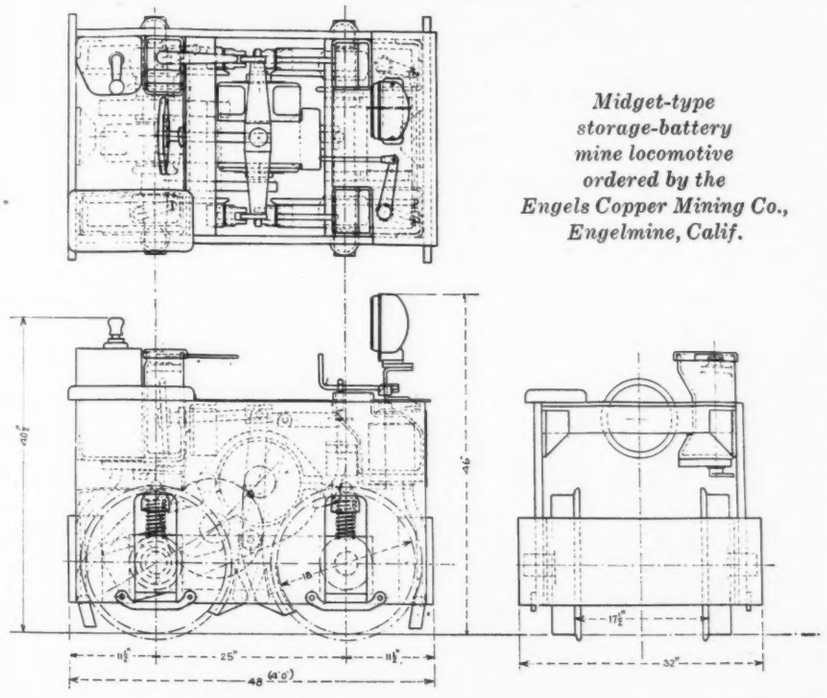
*Cents per share. †Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. K, Irregular. I, Initial. X, Includes extra.

Toronto quotations courtesy Arthur E. Moysey; Spokane, Pohlman Investment Co.; Salt Lake, Stock and Mining Exchange; Los Angeles, Chamber of Mines and Oil; Colorado Springs, Colorado Springs Stock Exchange.

NEW MACHINERY AND INVENTIONS

A Midget Mine Locomotive

Many metal-mining companies have undoubtedly felt the need of a storage-battery mine locomotive, small enough to be moved from level to level as required, yet capable of giving efficient service. Such a locomotive has recently been ordered by the Engels Copper Mining Co., Engelmine, Calif., from the Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa. The Westinghouse company is now prepared to furnish a small two-unit locomotive, of a type called the "Midget," which has a rated draw-bar pull of 400 lb. at 3.5 miles per hour, and a starting draw-bar pull of 500 lb. Specifications of the driving unit are:



Midget-type storage-battery mine locomotive ordered by the Engels Copper Mining Co., Engelmine, Calif.

Weight, lb.....3,375
Minimum gage, in.....18
Wheelbase, in.....25
Height over all, in.....46
Width over all, in.....32
Length over all, in.....48
Wheels, 18 in. dia., 2¾ in. tread; ⅞ × 1⅛ in. flange.
Journals, hub-bearing type
Springs, helical
Brakes, self-locking scissors type braking on all wheels
Sand boxes, 4
Frames, plate steel-outside of wheels

Important features claimed by the company to be embodied in the design of the driving unit are:

The double reduction gear motor, type V62-X-4. This motor drives the rear axle through double reduction gearing and is cradle-suspended. A footplate at the motorman's end of the locomotive can be easily lifted out of the way to oil or repack the motor cradle, axle, and jack shaft oil centers.

Type R-122-A controller of the straight rheostatic, reversing type.

Westinghouse-Cutter headlight, with concentrated filament, mounted on the front end of the driving unit.

Two Anderson charging plugs and one receptacle furnished as standard.

Side frames of plate steel, giving ample strength for the service.

Coil driving springs resting on top of the drving box affording easy riding qualities and absorbing shocks that would otherwise occur.

Four sand boxes to permit sanding the rails in front of the leading drivers for either direction of motion.

Though but one motor is used, full traction is obtained from the four driving wheels by the use of a chain between the axles. A roller chain and sprockets are used.

The motorman's seat at the controller end of the driving unit makes both the controller and brake wheel readily accessible. The motorman sits entirely within the framework of the driving unit.

The scheme of braking is essentially the same as is carried out on large mine locomotives, with one brake shoe at each wheel.

The battery trailing unit is designed to accommodate either thirty-eight cells of Ironclad Exide MV-9 or sixty-two cells of Edison A-4 battery. The specifications for this unit are:

Weight without battery, lb.....2,100
Weight with 38 cells MV-9, lb....3,485
Weight with 62 cells A-4, lb. 3,050
Minimum gage, in.....18
Wheelbase, in.....24
Height over all with Exide battery, in. 47½
Height over all with Edison battery, in. 45
Length over all, in.....48
Width over all with Exide battery, in. 32
Width over all with Edison battery, in. 33½
Bearings—Hyatt roller
Wheels—cast iron 12 in. diameter.
Springs—helical, located under battery crate.

The normal capacity of the lead battery is 136 amp.-hr. 10.16 kw.-hr. and of the Edison battery 150 amp.-hr., 11.2 kw.-hr.

The battery crate is constructed of angle iron and steel plate, and is supported upon the chassis by means of four coil springs, one at each corner. Provision is made to keep the springs from becoming unseated if the trailing unit is derailed. The ampere-hour meter is placed upon a support above the top of the battery crate and within convenient view of the motorman.

Sufficient room has been left between the crate and chassis to permit reaching in and uncoupling cars from the leading or driving unit.

No exposed switches are mounted on the battery unit. The jumper connection between units may be opened and serve as a battery disconnecting switch.

Two New Drills

Two new drills have been offered to mine operators by the Hardsocg Wonder Drill Co., Ottumwa, Iowa. One of these, the No. 3 hammer drill, is of the spool valve operated type, and the manufacturer claims that it is an exceedingly rapid driller with an unusually low consumption of air. It is claimed that it will do good work on low air pressure—from 40 to 60 lb. Extreme ruggedness in construction is another feature. An air strainer prevents foreign substances from entering the drill and causing injury to closely fitting parts or delay from stoppage of the machine. The oil chamber in the valve chest is roomy. The machine is fitted with a live air valve so that a large volume of high-pressure air can be sent through hollow drill steel, thus cleaning damp holes or holes of practically any depth.

The No. 4 drill is the water-type hammer drill which has the same general features of No. 3 with the addition of the water tube feature. An offset handle provides for removing the water tube, if desired, without taking the drill from the cradle or mounting. The water tube is held in place by an ordinary plug and there is no leak from the tube or water connection. The drill is removed from the cradle by loosening two nuts, and when removed it is a hand machine ready for use without adding any attachments. The rotator of the drill is exceptionally strong. Either a single or double screw column can be furnished as a mounting. The cradle (or shell) has a 24-in. movement on the slide, giving ample clearance for 2-ft. changes in drill steels if desired. In addition to this feed, there may be a movement of the slide on the mounting (which attaches slide to column) of 18-in. so that under any conditions the desired hole can be drilled without changing the set-up.

INDUSTRIAL NOTES

The Banka Drill

In the March 17, 1923, issue of the *Journal-Press*, J. B. Newsom, in an article entitled "Examination of Tin Deposits in the Federated Malay States," described the Banka drill and the mode of using it. Werf Conrad, of Haarlem, Holland, makers of the Banka drill, comment on the author's statements as follows:

"The description given is very misleading, as such drills as those referred to are very inferior imitations of the Banka. Not one of the parts described or illustrated is identical with the genuine Banka parts as manufactured by us. For instance, it is stated in Mr. Newsom's article that the casings used have small V threads which 'wear out rapidly, are easily smashed, and have a tendency to spread the sleeves when put under heavy strain.' This statement is particularly damaging to our reputation as makers of the original Banka drill and one which we must entirely refute. Our Banka casings have thick trapezoid threads of 5 mm. depth, which have been proved to withstand an enormous amount of wear and tear and rough usage under widely varying conditions, and no complaint has ever reached us as regards the tendency of the sleeves to spread under heavy strain.

"Further, it is stated that 'sometimes the pipe twists off at a joint.' This is not possible with the genuine Banka casings.

"We think it may be of interest to your readers to point out that the Banka hand drill, in its original form, was first introduced in 1858 for the prospecting and testing of alluvial tin-bearing ground in the island of Banka. Its practical usefulness soon secured for it a rapidly increasing demand, until today this boring apparatus is exclusively used all over that island.

"It was subsequently adopted for use in Surinam (Dutch Guiana) by Dutch mining engineers for prospecting alluvial gold-bearing deposits, and as result of its operations there became so much more widely known and appreciated that from that time onward it has secured the favor of mining engineers and prospectors in all parts of the globe.

"The only genuine Banka drill is made by us."

Walter Goodenough has joined the staff of Dwight P. Robinson & Co., Inc., New York.

Folke Sandelin, president of the Swedish Charcoal Steel Producers, Inc., distributors of SKF Hofors mining drill steel, and Olof Hjorth, manager of Hofors Steel Works, in Sweden, have just returned to New York after an 8,000-mile trip through the mining districts of the United States and Canada.

The Wah Chang Trading Corporation has moved its offices to more spacious quarters on the eighth floor of the Hudson Terminal Building, 50 Church St., New York.

The Swedish Charcoal Steel Producers, Inc., distributors of Swedish iron and steel, have appointed the Meagher-Mars Company as their Duluth representative.

J. W. Gardner, president of The Gardner Governor Co., of Quincy, Ill., recently sailed from Japan for the United States, on the last lap of his trip round the world which he began some time ago.

The General Engineering Co., Inc., consulting metallurgical engineers of Salt Lake City, Utah, announces the removal of its eastern office on May 1 to 50 Broad St., New York. C. E. Chaffin remains in charge of the eastern office.

Announcement is made by the Pure Carbon Co., Wellsville, N. Y., of the recent appointment of a Minneapolis representative, the Charles A. Etem Co., 917-A Marquette Ave., Minneapolis, Minn. The latter is prepared to give personal engineering service on all brush problems and requirements in its territory.

The C. J. Tagliabue Manufacturing Co., 18-88 Thirty-third St., Brooklyn, N. Y., announces that it has secured the sole manufacturing and selling rights for the "Tag-Hespe Red Reading Column," a device designed to facilitate the precise reading of mercury thermometers and involving a new method of tube construction.

Construction has been started by Dwight P. Robinson & Co., Inc., on an extension to the South Power Station of the Aliquippa Works of the Jones & Laughlin Steel Corporation near Woodlawn, Pa. The improvement includes preparation of site, foundations and condenser well, and the erection of an extension to the building to house a 10,000-kw. steam generator unit, with condenser and all other appurtenances. The installation of a new turbine-driven pump in the pump house, with connections to steam and water mains, is also included. Dwight P. Robinson & Co. also report a steady increase in the volume of industrial construction under way and contemplated.

The American Insulated Wire & Cable Co., of Chicago, Ill., began manufacturing magnet wire on April 1. Its products are sold under the trade name A-1 magnet wire and consist of the following: plain enameled; single cotton covered (S C C); double cotton covered (D C C); single cotton enameled (S C E); double cotton enameled (D C E); single silk covered (S S C); double silk covered (D S C); single silk enameled (S S E), and double silk enameled (D S E). A factory manager has been secured who has had twenty years' experience in this field and has developed magnet wire for two of the largest companies in the United States that are engaged in making this product.

TRADE CATALOGS

Catalogs for Brazil

Catalogs for Brazil should not have engraved or embossed covers or inserts. The import duty on catalogs is 150 gold reis per kilogram (about 5c. U. S. gold) but on engravings is 4,000 gold reis or $1.93 U. S. currency per kilogram. The tariff on *estampados* or steel engravings and fancy engraved sheets should in no sense apply to catalogs, but it lies entirely in the discretion of the inspector to call the whole thing engravings if he wants to. This authorizes a heavy fine, of which the inspector gets half.

Catalogs should not be shipped by freight, as five to six weeks are required to pass them through the custom house and storage must be paid during the time consumed.

Cartage and other incidental charges must be paid. To mail them from Rio to any Brazilian post office costs 0.4 real per gram, or 2¼c. per pound. They should not be sent by parcel post, as this is a new department of the Post Office and it is generally conceded that it is more difficult to get anything through that department than any other.

The easiest and quickest way is to mail the catalogs direct from the factory to the individual in Brazil. If the catalog is small it should be sent by first-class mail. If it is large it should be sent as printed matter. If immediate sales possibility depends upon it, it should be sent by registered first-class mail.

On a 400-lb. (gross) box of catalogs, 300 lb. net, custom house charges have been made of $160 plus the ordinary cartage and handling to be expected from custom house to office. The freight from New York to Rio with invoice, cartage, and incidental charges, is about $30. The postage for mailing in Brazil would be $7, a total of about $200-$300, say 70c. a pound and six weeks' loss of time, with the additional unperceived cost of overhead and worry, as well as more expensive office help in Brazil.

Wood Pipe—Catalog No. 18 of the Continental Pipe Manufacturing Co., Seattle, Wash., contains much information of all kinds regarding wood pipe in its 246 pages. Some of the large installations made by the company are described. A large section is devoted to engineering tables that may be found necessary in hydraulic calculations. The catalog is bound in cloth and is handsomely illustrated.

Tools—Hisey portable electric drills and reamers are described in the new sixteen-page bulletin No. 106 of the Hisey-Wolf Machine Co., Cincinnati, Ohio. Drilling stands and drill attachments and other drill and reamer accessories are included.